Gavilan Creek Study February 1969

for Santa Clara County Flood Control & Water District

by W. J. Hanna & Son - McCreary Koretsky Engineers

CALCULATIONS

SOILS REPORT

TA
710.4
G38.63
1969

107

BY AJW DATE 2-13-69 SUBJECT SHEET NO. 101 OF
CHKD. BY DATE JOB NO. 1317

Gavilan Creek Study

for

Santa Clara County Flood Control and Water District

Work Authorization #51026

by

W. J. Hanna & Son - McCreary-Koretsky-Engineers
A Joint Venture

Calculations

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 2-13-69 SUBJECT GAVILAN CREEK — CALCULATIONS — GENERAL SHEET NO. 102 OF

CHKD. BY DATE JOB NO. 1317

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Section 1

General

Project No 1317 Sheet 104 of

Title of Computation CANAL DESIGN CRITERIA Calc by AJW Date 11-4-68

Chkd by Date

CANALS:

The following are the Q's in which we are interested:

Reach*	Design	Upper Conf. Lim. (80%)	50 Year Storm
1	185 cfs	250 cfs	155 cfs
2	330	1,000	510
3	550	700	450
4	750	1,050	520
5	850	1,200	700

* These Reach Nos. are different from the Reach Nos. on the final Plates.

Freeboard, Lined and Unlined

Design Q	1 Ft.
Upper Conf. Limit	0 Ft.

Minimum Section, Lined and Unlined

b = 8' Min.
d = 8' Min.

Z = 2.0 Min., Unlined
Z = 1.5 Min., Lined, Subcritical
Z = Vert. only, Lined, Supercritical

Manning's "n"

n = 0.030 Unlined
n = 0.014 Concrete Lined
n = 0.013 Concrete Pipe

Velocity, Unlined

Use tractive force analysis and apply it to the 50-Year Storm.

REF.: Chow, "Open Channel Hydraulics", P. 311

Transition Loss = $c \Delta h_v$

Values of c:

Type of Transition	Inlet	Outlet
Warped	0.10	0.20
Straight Line	0.30	0.50
Square End	0.30	0.75

Open channel hydraulics were based on the Manning formula. Extensive use was made of the tables in King's "Handbook of Hydraulics".

Backwater Curves were run using the EGL rather than the HGL:

$$\Delta EGL = \left(\frac{S_1 + S_2}{2}\right) L = (S_1 + S_2)\frac{L}{2}$$

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BY AJW DATE 2-13-69 SUBJECT UNIT PRICES FOR FINAL ESTIMATES SHEET NO. 106 OF
CHKD. BY DATE JOB NO. 1317

Excavation	$1.00	per C.Y.
Embankment	0.40	" "
Sacked Concrete Rprap	50.00	" "
Structural Concrete	100.00	" "
Clearing, fields	300.00	per Acre
Clearing, fields with orchards	600.00	" "
Clearing, Orchards	800.00	" "
24"ϕ CMP	15.00	per LF
36"ϕ CMP	22.00	" "
24"ϕ Flap Gates	50.00	" Ea
36"ϕ Flap Gates	75.00	" "
Move House	5,000.00	per Ea
Bridge	10,000.00	" "

RCP: See Sheet 107

Jacked RCP: See Sheet 108, round off to nearest $10.00

The minor amount of fence work involved is assumed to be included in the clearing unit price.

EXCAVATION & EMBANKMENT

Common Exc., Canal		$1.20	CY
Common Emb, Canal		0.80	CY
Structure Exc.		4.00	CY
Structure Backfill		6.00	CY
Riprap	(120 PCF @ $6.00/Ton = $9.72)	10.00	CY

CONCRETE

Reinforced Concrete Structures		90.00	CY
Canal Lining, Plain 3" thick		60.00	CY

PIPE

Reduce pipe price by 30% if Jacked

36" ϕ R.C.P.	0.70 x 36 = 25.20	25.20	LF
42	0.75 x 42 = 31.50	31.50	LF
48	0.80 x 48 = 38.40	38.40	LF
54	0.85 x 54 = 45.90	45.90	LF
60	0.90 x 60 = 54.00	54.00	LF
72	1.00 x 72 = 72.00	72.00	LF
78	1.05 x 78 =	81.90	
84	1.10 x 84 = 92.40	92.40	LF
96	1.20 x 96 = 115.20	115.20	LF
108	1.30 x 108 = 140.40	140.40	LF
120	1.40 x 120 = 168.00	168.00	LF
Jacking		200.00	LF

{ Plus 90% of Pipe Price From Above }

Signs		40.00	Ea
Guardrail		4.00	LF
Asphalt Concrete	(150 PCF)	12.00	Ton
Base Course	(145 PCF)	3.00	Ton
Striping		0.05	LF

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BY AJW DATE 11-26-68 SUBJECT RCP Prices SHEET NO. 108 OF

CHKD. BY DATE JOB NO. 1317

Info. from Roger D. Watts, American Pipe & Constr. Co.

For jacking, we probably need rubber gasket joints and a double reinforcing cage.

This pipe will cost from 80¢ to $1.00 per inch of I.D.

① One contractor figure jacking at $1.50 per inch of O.D. plus the pipe price.

② Another uses $2.00 per inch of I.D.

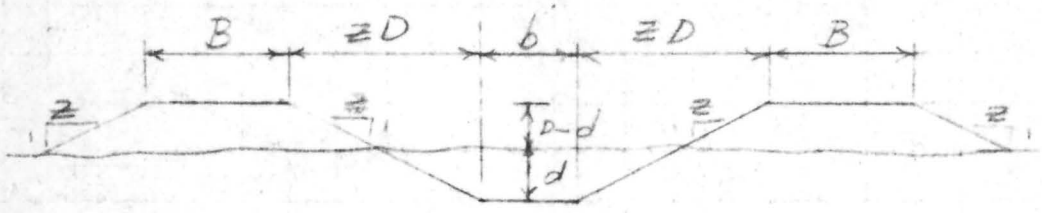
Using a wall thickness of 1" per foot of I.D.;
90¢ per inch of I.D. for pipe price;
and the formulae above,

I.D.	O.D.	Pipe Price	Jacking ①	Jacking ②	Total ①	Total ②
72"	84"	$64.80/LF	$126.00/LF	$144.00/LF	$190.80/LF	$208.80/LF
84"	98"	75.60	147.00	168.00	222.60	243.60
96"	112"	86.40	168.00	192.00	254.40	278.40
108"	126"	97.20	189.00	216.00	286.20	313.20
120"	140"	108.00	210.00	240.00	318.00	348.00

Project No 1317 Sheet 109 of

Title of Computation TRAPEZOIDAL CANAL CROSS SECT. AREA PROGRAM FOR OLIVETTI-UNDERWOOD PROGRAMMA 101 Calc by AJW Date 11-6-68

Chkd by Date



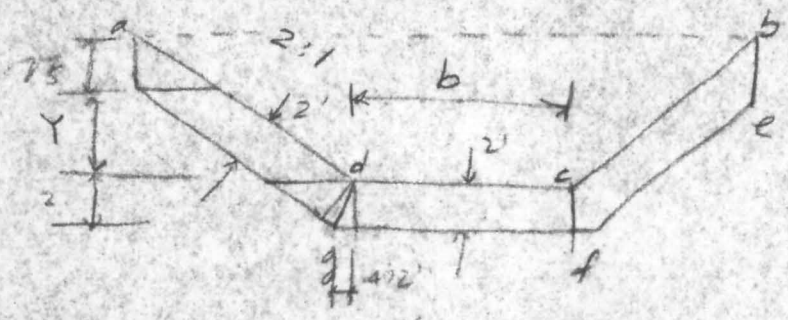
$$Cut = bd + zd^2$$

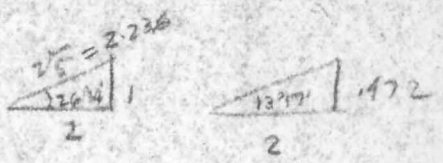
$$Fill = 2[B(D-d) + z(D-d)^2]$$

```
A V
  S
B ↑
S
B/↑
S
D ^
S
C ↑
A W
  S
D/↑
A *
B/↓
D/x
E ↕
D/↓
D/x
C x
E +
A ◇
A *
D ↓
D/-
E ↕
E ↓
```

```
B x
F ↕
E ↓
E x
C x
F +
F ↕
F ↓
F +
A ◇
A *
W
```

```
Touch V
Enter B
  "   b
  "   D
  "   z
  "   d
Prints Cut Area
Prints Fill Area
```





Area abefgh: $(4(\sqrt{5}+Y)+b)\sqrt{5} = 20 + 8.944Y + 2.236b$

$(2(2+Y)+2(.472)+b)(2+Y) = 9.888 + 6.944Y + 2b + 2Y^2 + bY$

$29.888 + 15.888Y + 4.236b + bY + 2Y^2$

Area abcd: $(2(2.236+Y)+b)(2.236+Y) = 10 + 6.708Y + 2.236b + bY + 2Y^2$

Area abefgh $19.888 + 9.180Y + 2b$

IF Y = THE VERT DIST BETWEEN THE INVERT AND THE CONTACT BETWEEN THE NONCOHESIVE & COHESIVE SOILS, AND b = THE INVERT WIDTH, THEN THE LINING AREA = $20 + 9Y + 2b$ (±)

Y	b=8	b=10	b=12	b=14	b=16
0	36.0	40.0	44.0	48.0	52.0
0.5	40.5				
1.0	45.0	49.0	53.00	57.00	61.00
1.5	49.5				
2.0	54.0	58.00	62	66.0	70.0
2.5	58.5				
3.0	63.0	67.0	71	75.0	79.0
3.5	67.5				
4.0	72.0	76.0	80.0	84.0	88.0
4.5	76.5				
5.0	81.0	85.0	89.0	93.0	97.0
5.5	85.5				
6.0	90.0	94.0	98.0	102.0	106.0
6.5	94.5				
7.0	99.0	103.	107.0	111.0	115.0
7.5	103.5				

Section 2

North Unit

Final:

Estimate

Comparisons

Calculations

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BY AMM DATE 2-11-69 SUBJECT TEXT TABLE 2 SHEET NO. 2 OF
CHKD. BY DATE NORTH UNIT JOB NO. 1317

ITEM	PRICE	REACHES 21-22a		REACHES 23-33		REACHES 34-39		TOTAL NORTH UNIT		SUM OF EXTENSIONS
Clearing	$300.00	0 A	$ 0	1 A	$ 300	0 A	$ 0	1 A	$ 300	$ 300
Clearing	800.00	4 A	3,200	1 A	800	4 A	3,200	9 A	7,200	7,200
Exc.	1.00	22,987 CY	22,987	8,443 CY	8,443	8828 CY	8,828	40,258 CY	40,258	40,258
Emb.	0.40	6,578 CY	2,631	0 CY	0	4,644 CY	1,858	11,222 CY	4,489	4,489
Rock Rip Rap	50.00	211 CY	10,550	45 CY	2,250	140 CY	7,000	396 CY	19,800	19,800
6" PCC	100.00	0 CY	0	129 CY	12,900	91 CY	9,100	220 CY	22,000	22,000
4" CMP	15.00	0 LF	0	0 LF		50 LF	750	50 LF	750	750
4" Aff. Gt.	50.00	0 Ea	0	0 Ea		1 Ea	50	1 Ea	50	50
3" PVC	38.41	0 LF	0	0 LF	0	26 LF	998	26 LF	998	998
8" RCP	81.25	0 LF	0	34 LF	2,785	0 LF	0	34 LF	2,785	2,785
Bridges	10,000.00	1 Ea	10,000	1 Ea	10,000	0 Ea	0	2 Ea	20,000	20,000
Flare Hdwl.	5,000.00	0 Ea	0	0 Ea	0	1 Ea	5,000	1 Ea	5,000	5,000
			$ 49,368		$ 37,478		$ 36,784		$ 123,630	$ 123,630
25%			12,342		9,370		9,196		30,908	30,908
			$ 61,710		$ 46,848		$ 45,980		$ 154,538	$ 154,538
R.O.W.	8,000.00	3.80 A	30,400	1.76 A	14,080	3.89 A	31,120	9.45 A	75,600	75,600
			$ 92,110		$ 60,928		$ 77,100		$ 230,138	$ 230,138
Construction			$ 49,400		$ 37,500		$ 36,800		$ 123,700	
Contingencies			12,400		9,400		9,200		31,000	
Right of Way			30,400		14,100		31,100		75,600	
Total			$ 92,200		$ 61,000		$ 77,100		$ 230,300	

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BY AJW DATE 2-3-69 SUBJECT REACHES 1, 1A, 2 SHEET NO. 203 OF
CHKD. BY DATE CONF. IIIa vs. CONF. VI JOB NO. 1317

ITEM		CONF. IIIa		CONF. VI	
Excavation	$1.00	40,300 CY	$40,300	28,200 CY	28,200
Embankment	0.40	11,300 CY	4520	16,000 CY	6,400
Sacked Concrete Riprap	50.00	396 CY	19,800	309 CY	15,450
Structural Concrete	100.00	192 CY	19,200	166 CY	16,600
24"ϕ CMP	15.00	50 LF	750	—	—
24"ϕ Flap Gates	50.00	1 Ea	50	—	—
36"ϕ CMP	22.00	—	—	50 LF	1,100
36"ϕ Flap Gates	75.00	—	—	1 Ea	75
48"ϕ R.C.P.	38.40	26 LF	998	—	—
54"ϕ R.C.P.	45.90	—	—	20 LF	918
78"ϕ R.C.P.	81.90	34 LF	2,785	—	—
84"ϕ R.C.P.	92.40	—	—	40 LF	3,696
Bridges	10,000.00	2 Ea	20,000	2 Ea	20,000
Move House	5,000.00	1 Ea	5,000	2 Ea	10,000
			$113,403		$102,439
+25%			28,351		25610
			$141,754		$128,049
R.O.W.	8,000.00	9.45A	75,600	9.47A	75,760
			$217,354		$203,809

CONF. VI DOES NOT HAVE ITS IE 8' BELOW GRADE FOR OVER 1600'. LOWERING IT SUFFICIENTLY TO MEET THIS REQUIRES THE ADDITION OF A DROP AND RESULTS IN CONF. VIa.

	CONF. VIa		
Excavation	41,300 CY	$1.00	$41,300
Embankment	16,200 CY	0.40	6,480
Sacked Concrete Riprap	309 CY	50.00	15,450
Structural Concrete	318 CY	100.00	31,800
36"ϕ CMP	50 LF	22.00	1,100
36"ϕ Flap Gates	1 Ea	75.00	75
54"ϕ RCP	20 LF	45.90	918
84"ϕ RCP	40 LF	92.40	3,696
Bridges	2 Ea	10,000.00	20,000
Move House	2 Ea	5,000.00	10,000
			$130,819
+25%			32,705
			$163,524

$243,294

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BY ... DATE 2-10-69 SUBJECT REALIES 1, 1A, 2 SHEET NO. 204 OF ...
CHKD. BY ... DATE ... CONF III a, Change Realign to Pipeline JOB NO. 1317
along Canal Alignment

Excavation	$1.00	40,300 CY − 8800 =	31,500 CY	$ 31,500
Embankment	0.40	11,300 CY − 4600 =	6,700 CY	2,680
Sacked Concrete Riprap	50.00	396 CY − 130 =	266 CY	13,300
Structural Concrete	100.00	192 CY − 71 =	121 CY	12,100
24"ϕ CMP	15.00	50 LF − 50 =	0 LF	0
24"ϕ Flap Gate	50.00	1 Ea − 1 =	0 Ea	0
48"ϕ RCP	38.40	26 LF − 26 =	0 LF	0
72"ϕ RCP	72.00	0 LF + 1700 =	1700 LF	122,400
78"ϕ RCP	81.90	34 LF + 0 =	34 LF	2,785
Bridges	10,000.00	2 Ea + 0 =	2 Ea	20,000
Morehouse	5,000.00	1 Ea + 0 =	1 Ea	5,000
		$ 113,403		$ 209,765
Plus 25%		28,351		52,441
		$ 141,754		$ 262,206
R.O.W.	8,000.00	9.45A 75,600	− 2.15 = 7.30A	58,400
		$ 217,354		$ 320,606

Sacked Concrete Riprap 7536' − Say 536 = Delete 7000' × .5 × 1/27 = 130 CY
Structural Concrete Delete 36 + 25 + 10 = 71 CY
R.O.W.: Save 55 × 1700' × 1/43,560 = 2.15 A

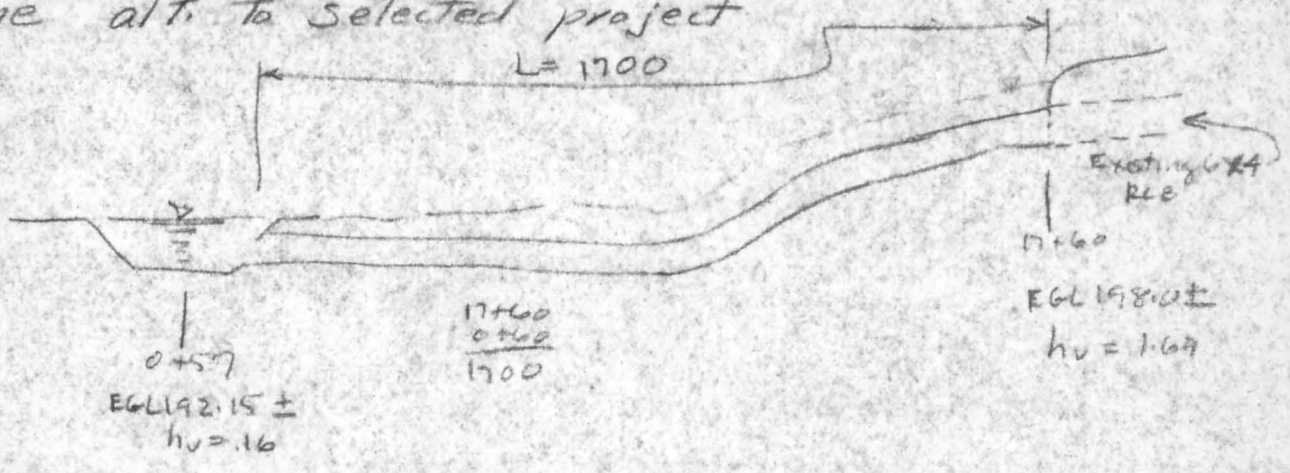
Emb.: Delete 125,380 CF = 4644 CY, Say 4600 CY
Exc.: Delete 238,355 CF = 8828 CY, Say 8800 CY

$ 320,606
− 217,354
$ 103,252 Extra

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BY. AdW DATE 2-10-69 SUBJECT Reach 1 SHEET NO 205 OF
CHKD. BY DATE Pipeline Alt. to Selected Project JOB NO. 1317
Pipe along Canal Route

Pipeline alt. to selected project



In existing 6x4 RCB $V = \frac{250}{24} = 10.42$ $hv = 1.69$

198.0
− 192.15
5.85 = H

Let upstream transition loss = .20 Δhv
Outlet loss = .30 Δhv

				Transition		Outlet				
ϕ	A	V	hv	Δhv	ht	Δhv	ho	S	hf	H=ho+hf+ht
5'	19.63	12.74	2.52	.83	.17	2.36	.71	.009211	15.66	16.54
6'	28.27	8.84	1.21	.48	.10	1.05	.32	.003476	5.91	6.33
6.5'	33.18	7.53	.88	.81	.16	.72	.22	.002278	3.87	4.25

$S = 4.66\left(\frac{Qn}{d^{8/3}}\right)^2 = 4.66\left(\frac{250 \times .013}{d^{8/3}}\right)^2 = \frac{49.22}{(d^{8/3})^2}$

6.33
− 5.85
0.48 x .5

For Q = 250, the estimated EGL u/s of the RCB = 202.2.
202.2 + .5 = 202.7 this might result in flooding

USE 6' ϕ RCP

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BY AJW DATE 2-10-69 SUBJECT Reaches 1, 1A, 2 SHEET NO. 206 OF
CHKD. BY DATE Conf III a, Change Reach 1 to Pipeline JOB NO. 1317
along Mesa Road

Excavation	$1.00	40,300 CY	−4,800 =	35,500 CY	$35,500
Embankment	0.40	11,300 CY	−4,600 =	6,700 CY	2,680
Sacked Concrete Riprap	50.00	396 CY	+27 =	423 CY	21,150
Structural Concrete	100.00	192 CY	−71 =	121 CY	12,100
24"ϕ CMP	15.00	50 CY	−50 =	0 LF	0
24"ϕ Flap Gate	50.00	1 Ea	−1 =	0 Ea	0
48"ϕ RCP	38.40	26 LF	−26 =	0 LF	0
72"ϕ RCP	72.00	0 LF	+2,000 =	2,000 LF	144,000
78"ϕ RCP	81.90	34 LF	+0 =	34 LF	2,785
Bridges	10,000.00	2 Ea	+0 =	2 Ea	20,000
Move House	5,000.00	1 Ea	+1 =	2 Ea	10,000
					$248 215
Plus 25%		$113,403			62,054
		28,351			$310,269
		$141,754			
R.O.W.	8,000.00	9.45 A 75,600	−1.25 =	8.20 A	65600
		$217,354			$375,869

Exc.: Delete 238,755 CF = 8828 CY Add 4028 CY = Delete 4800 CY
$(50 \times 874 + 50 \times 533 + 200 \times 192) \frac{1}{27} = 4028$

Emb.: Delete 125,380 CF = 4644 CY, Say 4600 CY

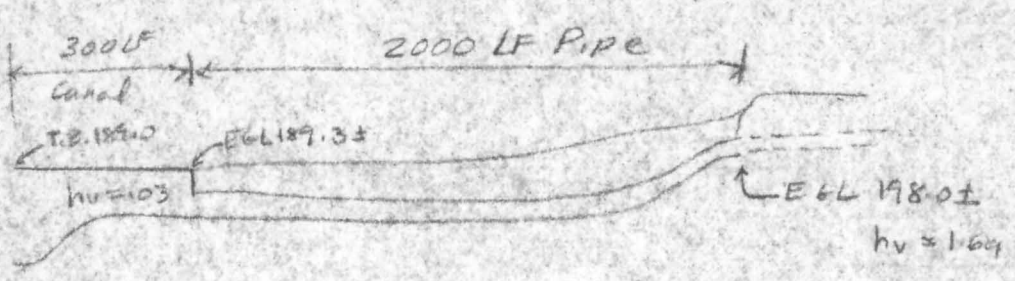
Sacked Concrete Riprap: Delete 7536# and Double Balance
$(18,961 - 7,536) 2 \times .5 \times \frac{1}{27} = 423$ 423 − 396 = Add 27 CY

Structural Concrete: Delete $36 \times 2.5 + 10 = 71$ CY

R.O.W.: Delete 3.89 A, Add $50' \times 2,300' = 115,000^{\square'} = 2.64$ A → Delete 1.25 A

$375,869
−217,354
$158,515 Extra

BY AJW DATE 2-10-69 SUBJECT Reach 1 SHEET NO. 207 OF
CHKD. BY DATE Pipeline Alt. to Selected Project JOB NO. 1217
Pipe along Mesa Rd



Canal: b=8 D=8 z=2 A=192 $V = \frac{25}{192} = 1.30$ $h_v = .03'$

198.0
-189.3
8.7 = H

Let u/s Transition loss = .20 Δh_v
and D/S outlet L_s = .30 Δh_v

$$S = 4.66\left(\frac{Qn}{d^{8/3}}\right)^2 = 4.66\left(\frac{25ax.013}{d^{8/3}}\right)^2 = \frac{49.22}{(d^{8/3})^2}$$

				Transition						
ϕ	A	V	h_v	Δh_v	h_t	Δh_v	h_o	S	Hf	$H = h_z + h_o + h_f$
5	19.63	12.74	2.52	.83	.17	2.49	.75	.009211	18.42	19.34
5.5	23.76	10.52	1.72	.03	.01	1.64	.51	.005535	11.07	11.59
6	28.27	8.84	1.21	.48	.10	1.18	.35	.003476	6.95	7.40

Use 6'ϕ

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BY AJW DATE 2-10-69 SUBJECT REACHES 1, 1A, 2 SHEET NO. 20X OF
CHKD. BY DATE Canal VI a - As shown in 2nd Progress Report JOB NO. 1317

Canal extends from Sta 0+00 to Sta 22+00
Use Canal + 54"ϕ RCP for Reach 1

Excavation	$1.00	41,300 CY		23,300	$ 23,300
Embankment	0.40	16,200 CY		10,200	4,080
Sacked Concrete Riprap	50.00	300 CY	+20 =	329	16,450
Structural Concrete	100.00	318 CY	−122 =	196	19,600
36"ϕ CMP	22.00	50 LF	+150 =	200	4,400
36"ϕ Flapgates	75.00	1 Ea	+ 3 =	4	300
54"ϕ RCP	45.90	20 Ea		20	918
84"ϕ RCP	92.40	40 Ea	−40 =	0	0
Bridges	10,000.00	2 Ea		2	20,000
More House	5,000.00	2 Ea		2	10,000
		$130,819			$ 99,048
Plus 25%		32,705			24,762
		$163,524			$ 123,810
R.O.W.	8,000	9.97A 79,760		5.81	46,480
		$243,284			$ 170,290

Exc.: 572,550 CF = 21,206 + 2,100 = 23,306, use 23,300
Emb.: 218,650 CF = 8,098 + 2,100 = 10,198, use 10,200
$\frac{(900-200)\,81}{27}$ = 2,100 CY Limit

Sacked Concrete Riprap: Add for 36"ϕ CMP: 22 × 24 = 528 SF
$2 \times 528 \times 5' \times \frac{1}{27} = 19.6$, Say 20 CY
Structural Concrete: Delete 55 + 25 + 10 + 32 = 122 CY

R.O.W.: Sta 0+00 to 21+00 230,000 SF
21+00 to 23+20: 220 × 100 = 22,000
At Flap Gates: 20 × 50 = 1,000
253,000 SF = 5.808 A

$ 217,354
170,290
$ 47,064 Saving

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BY AWW DATE 2-4-69 SUBJECT Regrad 2 SHEET NO. 209 OF
CHKD. BY DATE Cove VI a JOB NO. 137

STA	n	b	z	D	A	V	hv	IE	HGL	EGL	$\frac{D}{b}$	K'	$(\frac{1}{k'})^2$	S	S_1+S_2	$\frac{\Delta L}{N}$	ΔH
0+00	.030	8	2	12.60	418.32	2.39	.09	176.400	189.00	189.09	1.575		.0140	.000192			
															.000392	200	.08
2+00				12.48	411.34	2.43	.09	176.600	189.08	189.17	1.56		.0146	.000200			
															.000410	200	.08
4+00				12.36	404.42	2.47	.09	176.800	189.16	189.25	1.545		.0153	.000210			
															.000430	200	.09
6+00				12.24	397.56	2.52	.10	177.000	189.24	189.34	1.53		.016	.000220			
															.000449	200	.09
8+00				12.13	391.31	2.56	.10	177.200	189.33	189.43	1.5162		.01669	.000229			
															.000469	200	.09
10+00				12.02	385.12	2.60	.10	177.400	189.42	189.52	1.5025		.01745	.000240			
															.000483	50	.02
11+00				11.98	382.88	2.61	.11	177.450	189.43	189.54	1.4975		.01773	.000243			

$S = .000005$

$Q = 1000 \quad n = .030 \quad b = 8 \quad S = .013732 (\frac{1}{k'})^2$

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BY AJW DATE 1-3-69 SUBJECT REACHES 1, 1A, 2 SHEET NO. 210 OF
CHKD. BY DATE CONF. VII a JOB NO. 1317

STA.	T.B.	O.G.	CONTACT	I.E.	B	b	D	z	d	CUT	CUT	FILL	LINER
0+00	189.0			176.4							0	0	
2+00	189.04	189.12		176.5	15	8	12.48	2	12.62	5	419	0	2/81
4+00	189.08	187.4		176.6					10.8	5	320	62	
6+00	189.13	185.9		176.7	15	8	12.43	2	9.2	5	243	139	
8+00	189.17	185.9		176.8	15	8	12.37	2	9.1	5	238	141	
10+00	189.21	185.8		176.9	15	8	12.31	2	8.9	5	230	149	
12+00	189.25	185.0		177.0	15	8	12.25	2	8.0	5	192	200	
14+00	189.29	186.5		177.1	15	8	12.19	2	9.4	5	252	115	
16+00	189.34	186.3		177.2	15	8	12.14	2	9.1	5	238	128	
18+00	189.38	186.2		177.3	15	8	12.08	2	8.9	5	230	136	81
20+00	189.42	188.5		177.9	15	8	12.02	2	11.1	0	335	31	36/0
				177.45	15	8	11.99		13.55		2176	0	
21+00	189.44	191.0		182.6	15	8	8	2	8.64		218	0	
22+00		193.0		182.52					11.48		304	0	
23+00		198.0		182.68					15.32		592	0	
24+00		202.5		182.84	15	8	8	0	19.66		157/0	0	
24+72	203.30	206.0		191.46	15	8	17.34	0	14.54		0/116	0/84	
25+00	204.88	206.5		200.2	15	8	8.68	2	6.3		130	94	
26+00	205.16	207.8		201.16	15	8	8	2	6.64		141	48	
28+00		209.5		201.72					7.78		183	7	
30+00		210.5		202.28					8.72		281	0	
31+00		210.0		202.56					7.44		170	18	
32+00		206.0		202.84					3.16		45	239	
33+00		209.3		203.12					6.48		126	68	
34+00		213.5		203.40					10.40		285	0	
36+00		216.1		203.96					12.14		392	0	
38+00		216.3		204.52					11.78		372	0	
39+00		209.0		204.80					4.20		69	172	
39+50		208.0		204.85					3.15		45	240	
40+00		210.0		204.90	15	8	8	0	5.10		93	121	

973444 CF 294369 CF 141300 CF
36053 CY 10921 CY 5233 CY
5233 5233
41286 CY 16154 CY

STRUCTURAL CONCRETE

SEE CALCS FOR CONF. VI, III

Trans. below 6'x6' RCB	55 CY
Transition above 84"ϕ x 40' RCP	25
Headwalls for same	10
Transition below same	32
Transition below 6'x4' RCB	3
Headwalls for 54"ϕ x 20' RCP	10
Trans. & Diss. for Same	50
5' Drop	127
	318

R.O.W. Changes from VI below Sta 21 ~

STA	W	L	Wave	Area
0	100	300	100	30,000 □'
3	100			
3	110	800	110	88,000
11	110			
11	120	200	120	24,000
13	120			
13	110	800	110	88,000
21	110			

230,000 □' Conf VI a
-208,250 Conf VI
21,750 □' = .499 A additional

9.47
+ .50
9.97 A

Exc.	25,100 CY	$1.20	$ 30,120
Emb.	12,900 CY	0.80	10,320
Str. Exc.	12	4.00	48
Str. Backf.	12	6.00	72
Lining Conc.	100	60.00	6,000
Str. Concrete	40	90.00	4,320
42"ϕ RCP	150 LF	31.50	4,725
84"ϕ RCP	72 LF	92.40	6,653
Outlet Structure	1 Ea	LS	20,772
			$ 83,030

For "First Round" Comparison Only

	Str. Exc.	Backfill	L. Conc.	Str. Conc.
42"ϕ RCP	4 CY	4 CY	40±	18 CY
84"ϕ RCP	8±	8±	60±	30±
	12	12	100	48

17.9 + 8 + 17.9 = 43.8 3 x 8 = 24 $\frac{43.8+24}{2}$ = 34' = ave width transitions

STA	Row	AREA
40+	0	100 x 40
39+	60/90	300 x 90
36+	90	200 x 85
34+	80	100 x 75
33+	70	700 x 70
26+	70/90	140 x 90
24+60	90/130	60 x 20
24+	30/100	200 x 100
22+	100/130	200 x 85
20+	80	200 x 85
18+	90	400 x 90
14+	90	200 x 90
12+	95	200 x 95
10+	90	1000 x 90
0+	90	

= 7.69 Acres

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BY AJW DATE 1-3-69 SUBJECT REACHES 1A, 2 SHEET NO. 213 OF
CHKD. BY DATE CONF. III JOB NO. 1317

STA.	T.B.	O.G.	CONSTR	I.E.	B	b	D	z	d	CLAY	CUT	FILL	LINING
0+00	189.0			179.0			10				0	0	
2+00	189.12	189.12		179.32	15	8	9.8	2	9.8	5	270	0	9/81
4+00	189.24	187.4		179.64	15	8	9.6	2	7.76	3	183	69	63
6+00	189.36	185.9		179.36	15	8	9.4	2	6.54	1	138	119	45
8+00	189.48	185.9		180.28	15	8	9.2	2	5.62	0	108	159	36
10+00	189.60	185.8		180.60	15	8	9	2	5.20	0	96	172	
12+00	189.72	185.0		180.92	15	8	8.8	2	4.08	0	66	231	
14+00	189.84	186.5		181.24	15	8	8.6	2	5.26	0	97	145	
16+00	189.96	186.3		181.56	15	8	8.4	2	4.24	0	83	163	
18+00	190.08	186.2		181.88	15	8	8.2	2	4.32	0	72	177	
20+00	190.20	188.5		182.20	15	8	8	2	5.80	0	114	85	
21+00		191.0		182.36					8.64	0	248	0	30
22+00		193.0		182.52					10.48		304	0	0
23+00		198.0		182.68					15.32		542	0	
24+00		202.5		182.84	15	8	8	0	19.66		157/0	0	
24+72	203.80	206.0		191.46	15	8	17.34	0	14.54		0/116	0/84	
25+00	204.88	206.5		200.2	15	8	8.68	2	6.3		130	94	
26+00	209.16	207.8		201.16	15	8	8	2	6.64		141	48	
28+00		209.5		201.72					7.78		183	7	
30+00		210.5		202.28					8.22		201	0	
31+00		210.0		202.56					7.44		170	18	
32+00		206.0		202.84					3.16		45	239	
33+00		209.3		203.12					6.08		126	68	
34+00		213.5		203.40					10.10		285	0	
36+00		216.1		203.96					12.14		392	0	
38+00		216.3		204.52					11.78		372	0	
39+00		209.0		204.80					4.20		69	172	
39+50		208.0		204.85					3.15		45	240	
40+00		210.0		204.90	15	8	8	0	5.10		93	121	

677,599 CF 347,211 CF 21,900 CF
25,096 CY 12,886 CY 3,033 CY
3,033 3,033
28,129 CY 15,919 CY

SACKED CONCRETE RIPRAP

STA	WIDTH	AVE. W	LENGTH	AREA
0+00	$\sqrt{5} \times 19 = 43$	43	20	860 □'
0+20	43			
	$43+8=51$	93.5	80	7,480
1+00	$3\sqrt{5} \times 19 + 8 = 136$	116	50	8,300
1+50	$43 + 2\sqrt{5} \times 10 + 8 = 96$			

$16{,}640 \text{ □'} \times .5' \times \frac{1}{27} =$ **309 CY**

STRUCTURAL CONCRETE

Transition below 84"φ x 40' RCP

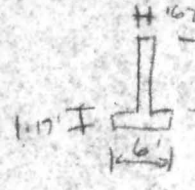
$8 + 2\sqrt{5}\,8 = 44'$ $\quad 3 \times 8 = 24'$

$\frac{44+24}{2} = 34'$ Ave. $\quad \frac{34 \times 50 \times .5}{27} =$ 32 CY

Transition Above Same

$\frac{34 \times 40 \times .5}{27} =$ 25

Headwalls for 84"φ RCP Say 12' long



$6.7' (10 \times 12 - 3.81 = 55$ CF

$1.17 \times 6 \times 12 =$ 84

$139 \text{ CF} \times \frac{1}{27} = 5 \text{ CY Ea} \times 2 =$ 10

Transition to 6' x 6' RCB 90' Long ±

$8 + 2\sqrt{5}\,8 = 44'$ $\quad 2 \times 8 + 6 = 22'$

$\frac{44+22}{2} = 33'$ Ave. $\quad \frac{33 \times 90 \times .5}{27} =$ 55

Headwalls for 54"φ RCP Similar to Headwalls above 10

Dissipator Dls from 54"φ x 20' RCP Simi to 40' Long above 25

Transition between 54"φ & 6' x 4' RCB

$2 \times 9 + 6 = 24'$ $\quad \frac{24 \times .5' \times 20'}{27} =$ 9

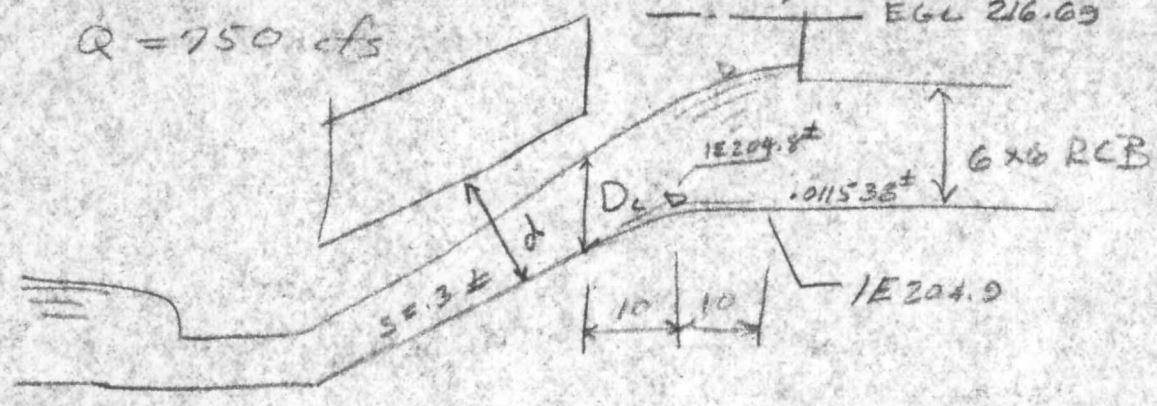
166 CY

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BY A/W DATE 2-3-69 SUBJECT Reaches 1, 1A, 2 SHEET NO. 215 OF
CHKD. BY DATE Conf VI JOB NO. 1317
ROW

STA	W	L	Wave	Area
0N	90'			
3N	90	300'	90'	27,000 □'
3N	100			
11N	100	800	100	80,000
11N	105			
13N	105	200	105	21,000
13N	100			
19N	100	600	100	60,000
19N	95			
20N	95	100	95	9,500
21N	120	100	107.5	10,750
22N	180	100	150	15,000
23N	290	100	235	23,500
23+80	0	80	145	11,600
24N	0 / 115			
25N	95	100	105	10,500
27N	95	200	95	19,000
27N	90			
30N	90	300	90	27,000
31N	100	100	95	9,500
33N	95	200	97.5	19,500
34N	95	100	95	9,500
38N	105	400	100	40,000
39N	110	100	107.5	10,750
40N	60	100	85	8,500

412,600 = 9.492 Acres



216.69
−204.90
11.79

$$K_c' = \frac{Q}{d^{5/2}}$$

d	$d^{5/2}$	K_c'	$\frac{D_c}{d}$	D_c	c	A	V	hv	D+hv
6	88.18	8.505	.9877	5.93	.0835	28.21	26.59	10.98	16.91
6.5	107.72	6.962	.9739	6.33	.7802	32.96	22.75	8.04	14.37
7	129.64	5.785	.9491	6.64	.7706	37.76	19.86	6.12	12.76
7.5	154.05	4.869	.9099	6.82	.7500	42.19	17.78	4.91	11.73

$0.3 \times 10 = 3$ $\quad 3 + 11.79 = 14.79 > 14.37$, $\quad$ Use $6.5'\phi = 78"\phi$ RCP

CONF III

STA 26+90 IE 204.8± S=.3
STA 22+30 IE 193.864 S=.001
460 10.936

$.3L + .001(460 - L) = 10.936$
$.3L + .46 - .001L = 10.936$
$.299L = 10.476$
$L = 35.037$, use 36'

26+90
36
26+54

STA 22+30 IE 193.864
STA 26+54 IE 194.288 S=.001
STA 26+90 PVI IE 204.728 S=.290

36
−10
26

SEE NEXT SHEET

For $Q=750$ $b=6$ $Z=0$ Min. $D+h_v = 7.86+3.93 = 11.79$

$IE = 204.9$ $HGL = 212.76$ $EGL = 216.69$ $\frac{D}{b} = 1.31$

$$S = \left(\frac{Qn}{b^{8/3}K'}\right)^2 = \left(\frac{750\times.014}{112\times.989}\right)^2 = \left(\frac{10.5}{117.7}\right)^2 = .007958$$

$d = 98"\phi = 6.5'\phi$ For $Q=750$ $D_c = 6.33$ $h_v = 8.04$ $D+h_v = 14.37$

$\frac{D}{d} = .9739$ $$S = \left(\frac{Qn}{d^{8/3}K'}\right)^2 = \left(\frac{750\times.013}{147\times.4920}\right)^2 = \left(\frac{9.75}{72.32}\right)^2 = .018176$$

$$S_{ave} = \frac{.007958+.018176}{2} = .013067$$

Transition Loss $= .1\,\Delta h_v = .1(8.04-3.93) = .41$

Let Transition be 20' Long $H_f = 20\times.013067 = .26'$

STA	IE	D	HGL	h_v	EGL
27+00	204.9	7.86	212.76	3.93	216.69
	S=.10838				
26+90	203.817				
	S=.21675				
26+80	201.65	6.33	207.98	8.04	216.02 + .41 + .26 = 216.69
	S=.21675				
26+46	194.280	4.245	198.525	16.583	215.108 + .91 = 216.02
	S=.1001				
22+30	193.864				

$d = 6.5'\phi$ $Q=750$ $n=.013$ $D=4.245$ $\frac{D}{d} = .6531$ $A = 22.95$ $V = 32.68$

$$S = \left(\frac{750\times.013}{147\times.3525}\right)^2 = \left(\frac{9.75}{51.82}\right)^2 = .035400$$ $h_v = 16.583$

$$h_f = \left(\frac{.035400+.018176}{2}\right)39 = .91$$

$$Z = \frac{V_1}{\sqrt{gD_1}} = \frac{32.68}{\sqrt{32.2\times4.245}} = \frac{32.68}{\sqrt{136.7}} = 2.79$$

$L = 5.4D_2 = 5.4\times8 = 43.2$, Use dissipator instead of jump alone

$\frac{(16+8+16)-8}{2} = 16$ $\frac{16}{\tan 22.5°} = 38.7'$, Use 40' Dissipator

78"ϕ x 34' RCP

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BY AJW DATE 2-5-69 SUBJECT REACHES 1, 1A, 2 CONF. IIIa SHEET NO. 218 OF
CHKD. BY DATE CONCRETE QUANTITIES JOB NO. 1317

SACKED CONCRETE RIPRAP

REACH	STA	WIDTH	LENGTH	AREA
2	0+00	$19\sqrt{5}=38$	50	1900 ft²
	0+50	38		
	0+50	$38+8=46$	50	4200
	1+00	$3\times38+8=122$	50	5325
	1+50	$2\times107\sqrt{5}+38+8=91$		
1A		$2\times9\sqrt{5}=40$	2@30	2400
1	0+00	$2\times8\sqrt{5}+8=48$	157	7536
	1+57	48		

$21{,}361 \text{ ft}^2 \times .5' \times \frac{1}{27} = \underline{396}$ CY

STRUCTURAL CONCRETE

REACH 2 — NONE

REACH 1A

2-Baffled Apron Drops @ 35 — 70 CY

Dissipator Below 78"ϕ x 34' RCP

$\frac{2\sqrt{5}\,8+8+3\times8}{2} 40\times.5\times\frac{1}{27} =$ — 25

Headwalls for Same Say 2@5 = — 10

Transition to 6x6 RCB

$\left(\frac{2\times13+8+3\times8}{2}\right) 20\times.5\times\frac{1}{27} =$ — 11

REACH 1

Dissipator below 48"ϕ x 26' RCP

Same as for 78"ϕ x 34'ϕ — 25

Headwalls for Same Say 2@5 = — 10

Transition above Same

$\frac{30}{40}\times 25 =$ — 19

Transition to 6x4 RCB

$\frac{40}{20}\times 11 =$ — 22

192 CY

REPLACE EACH 5' DROP W/ 16 LF 84" ϕRCP

TRANSITIONS $2\frac{1}{2} \times 8 + 9 = 44$ $13+8+13 = 34$ U/S $8+8+8 = 24$ D/S

$\frac{44+34}{2} \times 30 \times .5 \times \frac{1}{27} = 22$ CY $\frac{44+24}{2} \times 70 \times .5 \times \frac{1}{27} = 44$ CY

HEADWALLS 5 CY EACH $\times 2 = 10$

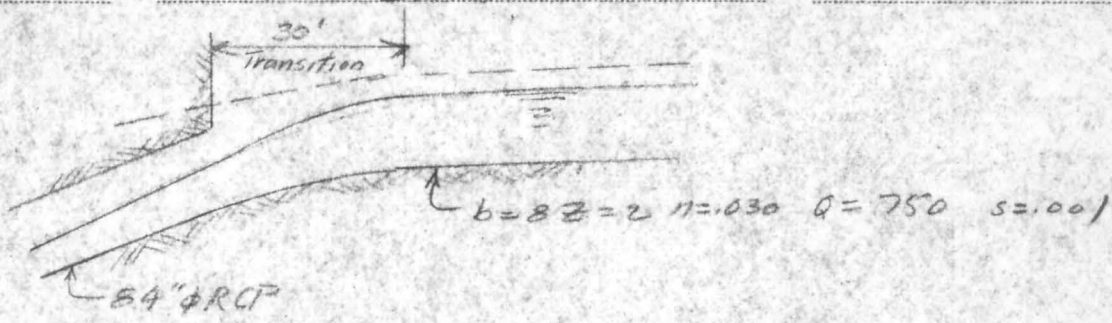
$22 + 10 + 44 =$ 76 CY STR. PCC/DROP

	STRAIGHT DROP	PIPE DRAIN
STR. P.C.C.	127 CY @ 100 = #12,700	76 CY @ 100 = #7,600
84" ϕRCP		16 LF @ 240 = 1478
	#12,900	9,078

STRUCTURAL CONCRETE, REVISED

Transition above 78" ϕRCP (See Old Calcs)		16 CY
Transition below same	$70 \times .5 \times 34 \times \frac{1}{27} =$	44
Transitions @ 84" ϕ RCP	$2 \times 63 =$	126
Transitions @ 48" ϕ RCP	$74 \times .5 \times 34 \times \frac{1}{27}$	47
Headwalls	$7 @ 5 =$	35
Transition to 6x4 RCB Say		16
		284 CY

THIS DROP WILL NOT WORK



84"ϕRCP Q=750 Find D_c

$K_c' = \frac{Q}{d^{5/2}} = \frac{750}{129.64} = 5.785$ $D_c = 7 \times .9491 = 6.64$

$A = cd^2 = .7706 \times 49 = 37.76$ $V = \frac{750}{37.76} = 19.86$ $h_v = 6.12$ $D + h_v = 12.76$

Channel Upstream

$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{750 \times .030}{256 \times .03162} = \frac{22.5}{8.095} = 2.779$ $D = 8 \times .9682 = 7.75$

$A = 182.125$ $V = 4.12$ $h_v = .26$ $D + h_v = 8.01$

Transition Loss $= .1 \Delta h_v = .1 (6.12 - .20) = .59$

S at pipe entrance

$S = \left(\frac{Qn}{K' d^{8/3}}\right)^2 = \left(\frac{750 \times .013}{.498 \times 179}\right)^2 = \left(\frac{9.75}{89.14}\right)^2 = .011964$

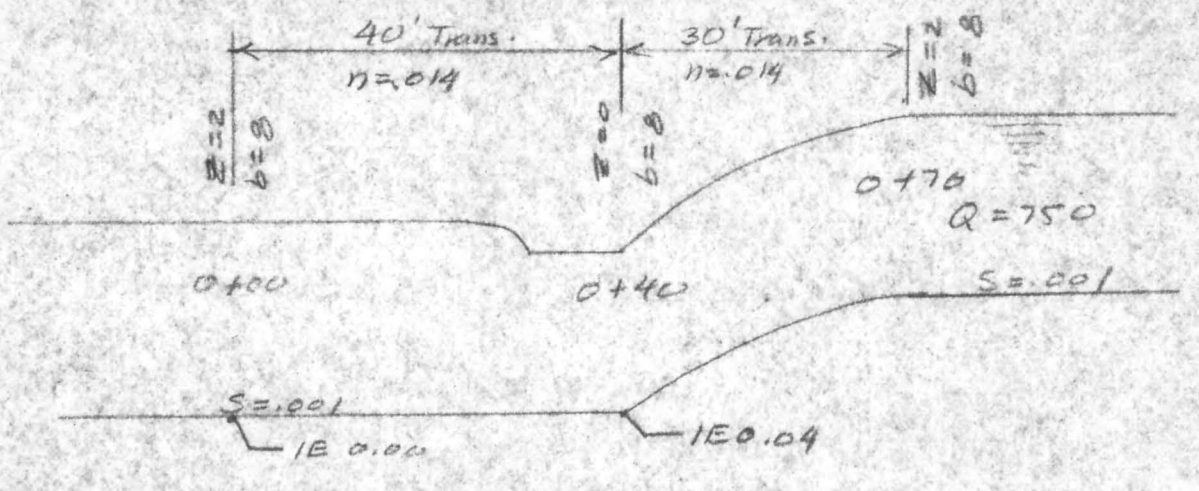
S at transition entrance

$S = \left(\frac{Qn}{K' b^{8/3}}\right)^2 = \left(\frac{750 \times .014}{2.779 \times 256}\right)^2 = \left(\frac{10.5}{711.4}\right)^2 = .000218$

Transition Friction Loss $= \left(\frac{.000218 + .011964}{2}\right) 30 = .18$

Let IE @ Pipe Entrance = 10.00
12.76
.59
+ .18
EGL @ Trans. Entrance 23.53
− 8.01
IE @ " " 15.52

For a 5' Drop the pipe is hardly needed — The transition will be involved enough that a straight drop will cost less.



$Q = 750 \quad n = .014 \quad b = 8$

STA 0+00 $K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{750 \times .030}{256 \times .03162} = 2.779 \quad D = 8 \times .9682 = 7.75$

$A = 182.125 \quad V = 4.12 \quad h_v = .26 \quad D + h_v = 8.01$

$S = \left(\frac{750 \times .014}{256 \times 2.779}\right)^2 = .000218$

STA 0+40 $D = 6.27 \quad A = 50.16 \quad V = 14.95 \quad h_v = 3.47 \quad D + h_v = 9.74$

$S = \left(\frac{Qn}{b^{8/3}}\right)^2 \left(\frac{1}{K'}\right)^2 = \left(\frac{750 \times .014}{256}\right)^2 \left(\frac{1}{K'}\right)^2 = .001682 \left(\frac{1}{K'}\right)^2$

$\frac{D}{b} = .78375 \quad \left(\frac{1}{K'}\right)^2 = 3.5848 \quad S = .006036$

$\frac{40 (S_1 + S_2)}{2} = 20 (.006036 + .000218) = .125$

$.5 \Delta h_v = (3.47 - .26) .5 = 1.605$

8.01
.125
+1.605
9.74 = El. EGL

STA 0+70 $D = 7.75 \quad h_v = .26 \quad D + h_v = 8.01 \quad S = .000218$

$\frac{30 (S_1 + S_2)}{2} = .094$

$.3 \Delta h_v = (3.47 - .26) .3 = .963$

9.74
.094
+.963
10.797
8.01
MIN. IE STA 0+70 2.787, USE 2.79

A 5' Drop is possible

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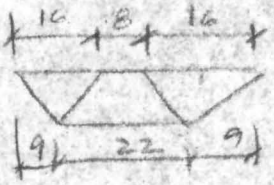
BY AJH DATE 2-5-69 SUBJECT REACH 1A SHEET NO. 222 OF
CHKD. BY DATE Cond III C JOB NO. 1317
BAFFLED APRON - 5' DROP

REF: USBR, "Hydr. Des. of Stilling Basins & En. Diss."

$Q = 750$ Let $q = 35$ $W = \frac{Q}{q} = \frac{750}{35} = 21.4$, Say 22'

$D_c = 3.4' \pm$ Block Ht. $= 2.65' \pm$ Block width $= 1.5 \times 2.65 = 4.0'$
Wall Ht. $= 3 \times 2.65 = 7.95'$, Use 8'

Upstream Transition



$L = \frac{9}{\tan 30°} = 15.6'$, Use 20'

Apron Block Spacing $= 2 \times 2.65 = 5.3'$
Length $= (4-1) = 3 \text{ Rows} \times 5.3 = 15.9$, Say 16' @ 2:1 = 8'
(10' @ 2:1 = 5')

DownStream Transition $L = \frac{7}{\tan 12.5°} = 21.7'$, Use 30'

Use Sacked Concrete Riprap along banks only

Structural Concrete:

Transition: $27.5 \times 8 + 8 = 44$ $\frac{44+38}{2} \times 20 \times .5' \times \frac{1}{27} = 15 \text{ cy}$
$2 \times 8 + 22 = 38$

Chute: $(2 \times 8 + 22) \cdot .07' \times 16' = 405 \text{ cf} =$ 15

Blocks: $4 \times 22 \times \frac{1}{2} = 44 \text{ LF}$ $44 \times 3.2 \times \frac{1}{27} =$ 5

35 cy



Sacked Concrete Riprap

$T_c \times 9. = 20'$ $2 \times 20 \times 30 \times .5 \times \frac{1}{27} = 22 \text{ cy}$

Str. Pcl 35 cy @ 100 = $ 3500
Sack. Pcl Riprap 22 cy @ 50 = 1100
$ 4600

CONF VI

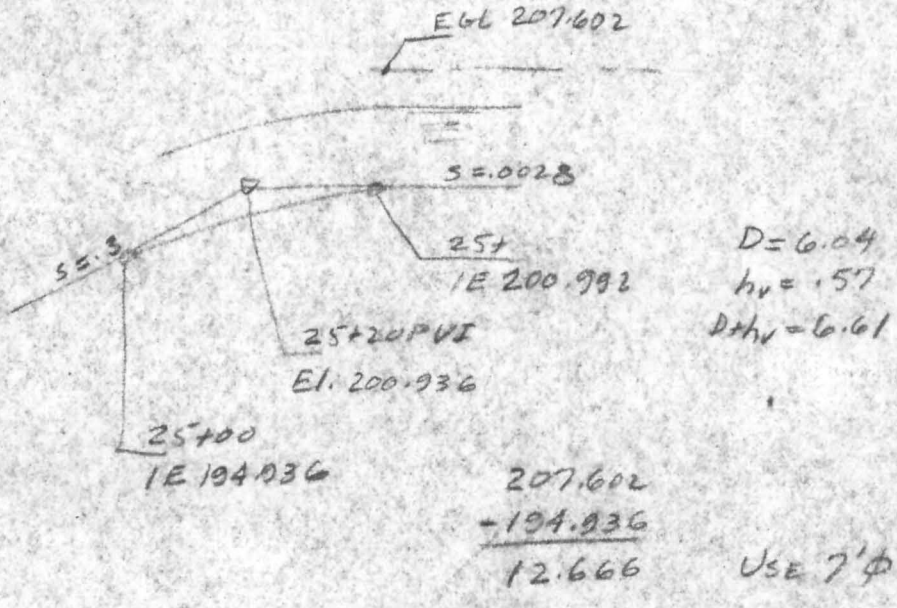
STA	39+00	IE	204.800	S = .0028
STA	25+20	IE	200.936	
STA	0+00	IE	109.000	S = .0016
	2520		21.936	

$(2520-L).0016 + .3L = 21.936$ Using 40' Transition, 40 LF RPE, And 40' V.C.

$4.032 - .0016L + .3L = 21.936$

$.2984L = 17.904$

$L = 60.000$



207.602
-194.936
12.666 Use 7'ϕ

CONF VI Use 84"ϕ x 40' RCP

$Q = 250 \quad n = .014 \quad Z = 0 \quad b = 6$

$192.5 - 192.0 = 0.5$ $\quad S = \frac{0.5}{220} = .002273 \quad S^{1/2} = .04768$

$$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{250 \times .014}{119 \times .04768} = \frac{3.5}{5.674} = .6168$$

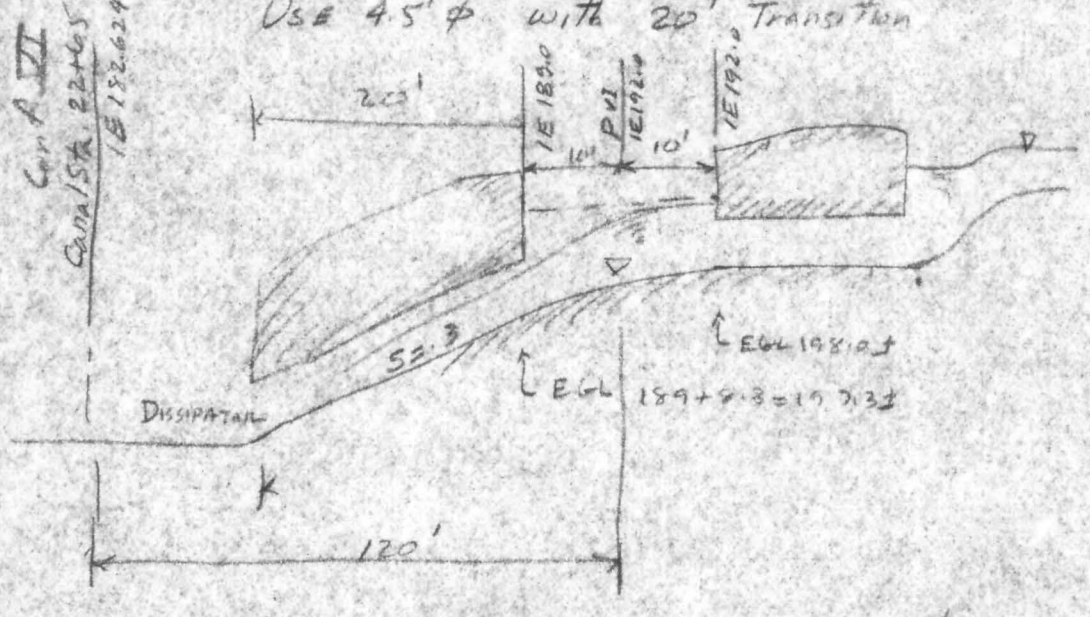
$D = 6 \times .8876 = 5.33 > 4$ $\quad \therefore$ Flows Full

$A = 6 \times 4 = 24 \quad V = 10.42 \quad h_v = 1.69 \quad D + h_v >= 5.69$

LET $D + h_v = 6$

$\frac{d}{4}$	$d^{5/2}$	K_c'	$\frac{D_c}{d}$	D_c	c	A	V	h_v	$D_c + h_v$
4	32	.7813	.9828	3.93	.7826	12.52	19.97	6.19	10.12
4.5	42.96	.5819	.9502	4.28	.7711	15.61	16.02	3.99	8.27
5	55.90	.4472	.8832	4.42	.7346	18.37	13.61	2.88	7.30
5.5	70.94	.3524	.8020	4.41	.6754	20.43	12.24	2.33	6.74
6.0	88.18	.2835	.7220	4.33					

Use 4.5' ϕ with 20' Transition



6x4 RCB Flowing Full: $A = 24 \quad P_w = 20 \quad R = \frac{24}{20} = 1.2 \quad R^{2/3} = 1.129$

$$S = \left(\frac{Qn}{1.486 AR^{2/3}}\right)^2 = \left(\frac{250 \times .014}{1.486 \times 24 \times 1.129}\right)^2 = .007556$$

$H_f = SL = .007556 \times 20 = 1.66$ $\quad$ Let Inlet Losses = .5 h_v = .85'

$198.0 + 1.66 + .85 + 1.69 = 202.2 = EGL\ U/S$

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 2-4-69 SUBJECT REACHES 1, 1A, 2 SHEET NO. 225 OF
CHKD. BY DATE Conf III JOB NO. 1317

STA	T.B.	O.G.	I.E.	B	b	D	Z	d	Clay	Cut	Fill	Lining
0+00	191.00	191.0	180.89	15	8					0	0	0
1+00	191.08	191.0	181.06	15	8	10.08	2	10.0	7.0	280	2	0
2+00	191.16	191.0	181.16	15	8	10.00	2	9.84	6.9	272	5	0/98
4+00	191.32	190.8	181.48	15	8	9.84	2	9.52	6.8	248	17	77
6+00	191.48	191.6	181.80	15	8	9.68	2	9.80	6.7	270	0	96
8+00	191.64	191.0	182.12	15	8	9.52	2	8.88	6.6	229	21	94
10+00	191.80	191.8	182.44	15	8	9.36	2	8.36	6.5	207	34	95
12+00	191.96	190.8	182.76	15	8	9.20	2	8.04	6.0	194	40	90
14+00	192.12	191.2	183.03	15	8	9.00	2	8.17	6.0	199	31	
15+00		192.5	183.13	15	8	8	2	9.37	6.0	251	0	
16+00		193.0	183.23					9.77	6.8	269	0	
17+00		194.6	183.38					11.27	6.0	344	0	
18+00		196.1	183.43					12.67	6.0	422	0	99.0
18+80		196.8	183.51					13.29		460	0	
18+80		196.8	188.51					8.29		204	0	
19+30		197.8	188.56					9.24		245	0	
20+30		199.3	188.66					10.64		312	0	
21+30		201.3	188.76					12.54		415	0	
22+30		202.4	188.86					13.54		475	0	
22+30		202.4	193.86					8.54		214	0	
23+00		203.0	193.93					9.07		227	0	
24+00		204.2	194.03					10.17		288	0	
25+00		206.1	194.13					11.97		382	0	
26+30		209.0	194.26	15	8	8	0	14.74		118/0	0	
1+00		191.0	182.96	15	8	9.1	2	8.04		0/194	0/36	
3+00		190.0	182.96					7.02		155	80	
5+00		182.0	183.00					6.00		120	131	
7+00		188.5	183.02					5.48		104	161	
9+00		187.0	183.04					3.96		63	260	
9+44		192.0	183.05	15	8	9.1	0	8.95		72/280	5/0	
9+70		194.8	183.45	15	8	12.5	0	9.35		0/75	640/195	
10+00		196.8	183.95	15	8	8	2	6.85		149	40	
12+00		197.6	183.27					7.63		177	12	
14+00		197.6	183.99					7.61		177	12	
15+00		200.5	190.00					10.50		305	0	
16+00		196.8	190.01					6.79		147	42	
17+50		195.0	190.03	15	8	8	0	7.97		64	1	

Cut = 471.03 cf = 17.446 cy
Fill = 2 manholes = 1037 cf
Lining = 1887 sq.ft. = 55.41 cy

Cut = 227.960 cf = 8.443 cy
Fill = 0

Cut = 238.355 cf = 8828 cy
Fill = 12538.00 = 464 cy

937.398 cf 155.380 cf 4496.00 cf

Ea 1B 5.681 5.541 11.222 cy

34.716 cy 5.541 40.257 cy

SACKED CONCRETE RIPRAP

STA	WIDTH	LENGTH	AREA
REACH 1			
0	17x2 = 38	50	1,900 ☐'
0+50	38		
0+50	38+8=46	50	4,200
1+00	3x38+8=122	50	5,325
1+50	$2\sqrt{5}$x10+38+8=91		
REACH 2			
0+00	$2\sqrt{5}$x9+8=48	157	7,536
1+57	48		

18,961 ☐' x 5 x $\frac{1}{27}$ = 351 cy

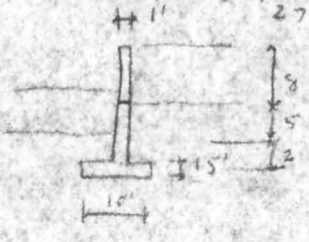
STRUCTURAL CONCRETE

REACH 1A

Transitions at drops $2\sqrt{5}$x8+8 = 44'

100x44'x.5'x$\frac{1}{27}$ = 81 CY Ea x 2 = 162 cy

Drops



4x8+8 = 40' Long w/ 12' opening

(7+15)40 = 880

(15+15)12 = 360

1240 CF = 46 CY Ea x2 = 92

Transition below RCP

70'x44'x.5'x$\frac{1}{27}$ = 57

Headwalls For 78" RCP Say 12' Long



.67x(10x12-33) = 58 CF

1.17x6x2 = 84

142 CF x $\frac{1}{27}$ = 5CY Ea x2 = 10

Transition between 78" RCP & 6x6 RCB 20 Long

Ave. 13' Deep Width = 6.25', Say 7'

2x13+7 = 33' Say 8" thick

.67x33x20 = 440 CF = 16 CY 16

REACH 1

Transition below 48" RCP 44'x44'x5'x$\frac{1}{27}$ = 36

Transition above same 30x44x.5x$\frac{1}{27}$ = 25

Headwalls 2@5 = 10

Transition to 6x4' RCB Say 20

428 CY

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BY AJK DATE 2-3-69 SUBJECT REACHES 1, 1A, 2 SHEET NO. 327 OF
CHKD. BY DATE CONF III JOB NO. 13.7
R.O.W.

REACHES 2, 1A $90' \times 2690' \times \frac{1}{43560} = 5.558\,A$

REACH 1

0+00 to 8+00	$100' \times 800' =$	$80,000\,\square'$
8+00 to 9+50	$110 \times 150 =$	$16,500$
9+50 to 14+00	$90 \times 450 =$	$40,500$
14+00 to 16+00	$95 \times 200 =$	$19,000$
16+00 to 17+50	$90 \times 150 =$	$13,500$
	$169,500\,\square' =$	3.891
		$9.449\,A$

$Q_{50} = 510 \cdot f_s$ $\quad b=8 \quad Z=2 \quad n=.030 \quad S=.0016$

$$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{510 \times .03}{256 \times .04} = 1.494$$

$D = 8 \times .7285 = 5.83$ $\qquad \frac{b}{y} = \frac{1}{.7285} = 1.373$

$A = 114.62$ $\qquad V = \frac{510}{114.62} = 4.45$

$T = .85 \times 62.4 \times 5.83 \times .0016 = 0.49$ PSF → OK For PI ≥ 7

HA-8 includes SM with $D_{75} = .20$ mm

$V_{allow} = 1.75 \times 1.14 \times 1 \times .76 = 1.52$ fps < 4.45

STA	n	b	Z	D	A	V	hv	IE	HGL	EGL	D/b	K'	$(\frac{1}{K'})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
2+50	.014	8	2	8.18	199.26	3.76	.22	182.60	190.78	191.0	1.0225		.1015	.000171	.00494	25	.12
2+00	.014	8	0	6.90	55.20	13.59	2.87	182.68	189.55	192.45	.8625		2.82	.008743			

$S=.0016\left(\frac{1}{K'}\right)^2$ $Q=750$

$(2.87-.22)\cdot 5 = 1.33$ $191.00+1.33+.12=192.45$

3+00	.013	7'φ	5.63	33.17	22.61	7.94	182.68	188.81	196.25	.8043	.4552		.01432	×72 =			8.62
3+72	.013	7'φ	5.63	33.17	22.61	7.94	191.30	196.93	204.87	(7.94 - 2.87) .75 = 3.80				192.45+3.80=196.25			
3+72	.0148	0	15.19	121.52	6.17	.54	191.30	200.49	207.08	1.899	.4325		.000727				

$(7.94-.54)\cdot 3 = 2.21$ $204.87+2.21 = 207.08$ $\frac{.00133}{20}$ .03

4+12	.014	8	2	6.13	124.19	6.04	.57	200.42	206.55	207.12	.7662		.3616	.000608			

$(.59-.57)\cdot 3 = .01$ $207.04+.03+.01 = 207.12$

South Parallel to Expressway to Mesa Rd.; Pickup REACH 13, Flow East along Mesa Road to Grandview Creek.

After Examining the profile, increase all stations by 100' and all elevations by 0.16'

$\left(\frac{750\times.013}{179\times.4552}\right)^2$

$Q=1000$ $b=8$ $Z=2$ $n=.030$ $S=.0016$ $K'=\frac{1000\times.03}{256\times.04}=2.930$ $D=8\times.9917=7.93$

$A=182.21$ $V=5.29$ $h_v=.43$ $D+h_v=8.36$, Use 8.40 $162.60+8.40=191.0$

$Q=750$ $b=8$ $n=.014$ $S=.00162\left(\frac{1}{K'}\right)^2$

STA	b	D	z	A	V	h_v	IE	HGL	EGL	$\frac{D}{b}$	$(\frac{1}{K'})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
0+00	8	10.00	2	280.00	3.57	.20	181.000	191.00	191.20	1.25	.0409	.000562			
													.001245	200	.25
2+00	8	9.58	2	260.89	3.84	.23	181.640	191.23	191.45	1.1975	.0477	.000683			
													.001500	200	.30
4+00	8	9.21	2	243.33	4.11	.26	182.280	191.49	191.75	1.15125	.05951	.000817			
													.001771	195	.35
5+90	8	8.90	2	229.62	4.36	.30	182.804	191.80	192.10	1.1125	.0695	.000954			
7+90	"	9.04	"	235.76	3.18	.16	"	191.94	192.10	1.13	.0647	.000500			
													.001026	105	.11
8+00	8	8.94	2	231.37	3.24	.16	183.114	192.05	192.21	1.1175	.0681	.000526			
													.001109	200	.22
10+00	8	8.74	2	222.69	3.37	.18	183.514	192.25	192.43	1.0925	.075425	.000583			
"	"	4.51	"	76.76	9.77	1.48	188.514	193.02	194.50	.56375	1.3225	.010216			
													.014624	25	.37
12+50	8	5.51	2	104.80	7.16	.80	188.564	194.07	194.87	.68875	.570625	.004408			
													.008002	25	.20
13+00	8	5.78	2	118.06	6.63	.68	188.614	194.39	195.07	.7225	.46525	.003594			
													.006746	25	.17
13+50	8	5.96	2	118.72	6.32	.62	188.664	194.62	195.24	.745	.408	.003152			
													.005983	25	.15
14+00	8	6.11	2	123.54	6.07	.57	188.714	194.82	195.39	.76375	.3605	.002831			
													.005430	25	.14
14+50	8	6.23	2	127.47	5.88	.54	188.764	194.99	195.53	.7775	.3365	.002599			
													.005009	25	.13
15+00	8	6.34	2	131.11	5.72	.51	188.814	195.15	195.66	.7925	.312	.002410			
													.004681	25	.12
15+50	8	6.43	2	134.3	5.59	.49	188.864	195.29	195.78	.80375	.2944	.002271			
"							193.864								

STA 0+00 TO 21+50 IS, ESSENTIALLY, THE ADOPTED PROFILE

8+00	8	4.51	2	76.76	9.77	1.48	188.514	193.02	194.50	.56375	1.3225	.010216			
													.014424	25	.36
8+50	8	5.59	2	106.61	7.04	.77	188.52	194.03	194.86	.69825	.54975	.004208			
													.007523	25	.19
9+00	8	5.87	2	115.87	6.47	.65	188.53	194.40	195.05	.73375	.435625	.003365			
													.006235	25	.16
9+50	8	6.03	2	122.90	6.10	.58	188.54	194.63	195.21	.76125	.3715	.002870	.005948		.13
		6.27		128.79	5.82	.53		.82	.35	.774375	.332725	.002517	.005415	25	.14
10+00	8	6.26	2	128.46	5.89	.53	188.55	194.81	195.34	.7825	.3295	.002545			
													.004897	25	.12
10+50	8	6.41	2	133.46	5.62	.49	188.56	194.97	195.46	.80125	.298	.002382			
													.004409	25	.11
11+00	8	6.54	2	137.86	5.44	.46	188.57	195.11	195.57	.8175	.27275	.002107			
													.004052	25	.10
11+50	8	6.66	2	141.99	5.28	.43	188.58	195.24	195.67	.8325	.25175	.001945			

$Q=1000$ $b=8$ $n=.03$ $S=.013733\left(\frac{1}{K'}\right)^2$ $Q=750$ $b=8$ $n=.03$ $S=.007725\left(\frac{1}{K'}\right)^2$

$K_o' = \frac{Q}{b^{5/2}}$ $Q=750$ $b=8$ $K_c' = \frac{750}{181.02} = 4.143$ $z=2$ $D_c = 8 \times .5643 = 4.51$

STA	b	z	n	D	A	V	h_v	IE	HGL	EGL	$\frac{D}{b}$	$\left(\frac{1}{K'}\right)^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
25+00	8	2	.014	7.85	186.05	4.03	.25	194.21	202.06	202.31	.98125	.12225	.000206	.005895	25	.15
25+50	8	0	.014	6.42	57.36	14.60	3.31	194.26	200.68	203.99	.8025	3.3825	.005689			
						(3.31-.25).5 = 1.53			202.31+1.53+.15 = 203.99							
25+50	6.5′ϕ	.013		6.25	32.96	22.75	8.04	194.26	200.59	208.63	.9738	$\left(\frac{Y}{.9421}\right)^2$	.018165			
						(8.04-3.31).75 = 3.55			203.99+3.55 = 207.54 < 208.63			DISSIPATIC	NEEDED			
26+00	6.5′ϕ	.013		6.33	32.96	22.75	8.04	195.17	201.50	209.54		.018165		.036332	25	.91
26+50	6.5	.014		4.37	28.41	26.40	10.82	195.18	199.55	210.37						
						(10.82-8.04).3 = .83			209.54+.83 = 210.37							

Q=750 n=.014 b=8 $S = .001682\left(\frac{1}{K'}\right)^2$

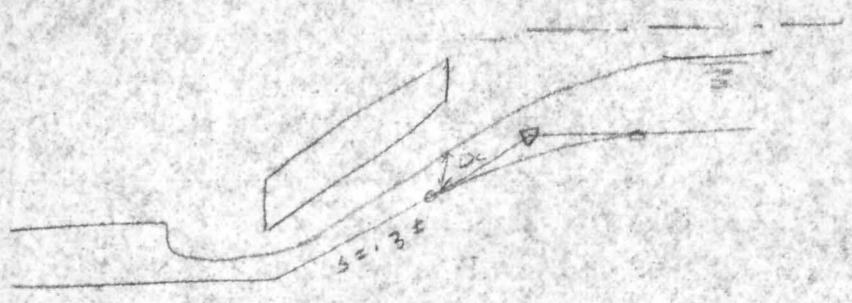
USE THE $6\frac{1}{2}'\phi = 78''\phi$

Q=750 n=.013 d=6.5 $S = \left(\frac{Qn}{K'd^{8/3}}\right)^2 = \frac{.004397}{(K')^2}$

$K_c' = \frac{Q}{d^{5/2}} = \frac{750}{6.5^{5/2}} = \frac{750}{107.7} = 6.96$ $D_c = .9739 \times 6.5 = 6.33$

STA	b	z	n	D	A	V	h_v	IE	HGL	EGL	$\frac{D}{b}$	$\left(\frac{1}{K'}\right)^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
25+00	8	2	.014	7.85	186.05	4.03	.25	194.21	202.06	202.31	.98125	.12225	.000206	.005895	25	.15
25+50	8	0	.014	6.42	57.36	14.60	3.31	194.26	200.68	203.99	.8025	3.3825	.005689			
						(3.31-.25).5 = 1.53			202.31+1.53+.15 = 203.99							
25+50	7′ϕ	.013		6.64	37.04	19.87	6.13	194.26	200.90	207.03	.9486	K'=.498	.011963	.023926	25	.60
						(6.13-3.31).75 = 2.12			203.99+2.12 = 206.11, use 207.03			DISSIPATIVE NEEDED				
26+00	7′ϕ	.013		6.64	37.04	19.87	6.13	203.26	209.90	216.03	.9486	K'=.498	.011963			
26+00	7′ϕ	.014		6.64	37.04	19.87	6.13	203.26	209.90	216.03	.9486	K'=.498	.012874	.024838	10	.22
26+20	6	0	.014	7.86	47.16	15.90	3.93	204.9	212.76	216.69	1.31	1.023	.007964			
						(6.13-3.93).2 = .44			216.03 + .44 + .22 = 216.69							
26+20	6	0	.014		36.00											

$K_c' = \frac{750}{36^{5/2}} = 5.785$ $D_c = 7 \times .9491 = 6.64$ Q=750 n=.013 d=7 $S = \left(\frac{750 \times .013}{\quad}\right)^2 = .01196.3$



Q=250 b=8 z=2
S=.0101 n=.030
D=7.94 A=189.61
V=1.32 hv=.03
D+hv=7.97

$Q=250 \qquad K_c' = \frac{Q}{d^{5/2}}$

d	$d^{5/2}$	K_c'	$\frac{D_c}{d}$	Dc	c	A	V	hv	Dc+hv
4	32	7.813	.9828	3.93	.1826	12.52	19.97	6.19	10.12
3.5	22.92	10.91	Flows Full		.1854	9.621	25.98	10.48	13.08 Min

TRANSITION To b=4 z=0 $4\times7.94+8=39.76$ $\frac{39.76-4}{2}=17.88$

$\frac{17.88}{\tan 30^\circ}=31'$ O/S $\qquad \frac{17.88}{\tan 22.5^\circ}=43'$ O/S

$\frac{31}{2}\times.3=4.65$ $\qquad 4.65+7.97=12.62$ 4'ϕ needed

$\frac{31}{2}\times.4=6.20$ $\qquad 6.20+7.97=14.17$

To flow full, we need $D=3.5\times1.5=5.25$ $\qquad 5.25+10.48=15.73$

This is becoming quite a structure, so use 4'ϕ

189.923
−182.954
6.969

$.0001(985-L)+.3L=6.969$

$.0985-.0001L+.3L=6.969$

$.2999L=6.8705 \qquad L=22.978$, use 23'

STA	IE	D	HGL	h_v	EGL
10+00	182.952	7.94	197.89	.03	197.92
9+85	189.250 PVI				
9+70	185.450	3.93	189.380	6.19	195.57 + 1.85 = 197.42 < 197.92
9+62	183.050 PVI	[7.06]	190.11	2.45	192.56 < 195.57
9+49	183.048 b=4 z=0	7.39	194.49	1.12	191.56 + 1.00 = 192.56
9+00	183.044 b=4 z=0	7.94	190.98	.03	191.01 + .55 = 191.56

Inlet Transition Loss = $.3\Delta h_v = .3(6.19 - .03) = 1.85$

195.57
191.01
4.54 Let h_v @ Outlet = 4.2

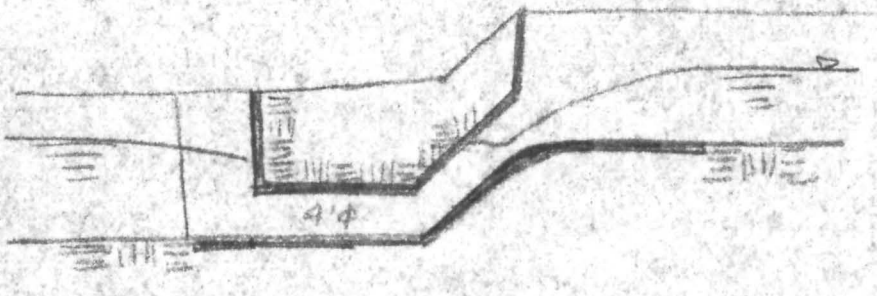
9+49 b=4 z=0 n=.014

Trans. Loss = $.5\Delta h_v = .5(1.12 - .03) = .55$

9+49 d = 4'ϕ $\frac{D}{d} = 1$ A = 12.57 h_v = 2.45

Exit Loss = $.75\Delta h_v = .75(2.45 - 1.12) = 1.00$

FRICTION NEGLECTED ABOVE



Worst Soil Condition: D_{75} = .20 mm HAB

Using Curve 2, V_{allow} = Chart Value × D × A × B

$V_{allow} = 1.7 \times D \times 1 \times .72 = 1.224D$

$Q_{50} = 155$ cfs for $b = 8$, $z = 2$, $A = 2d^2 + 8d$

d	A	$V = \frac{155}{A}$	D	V_{allow}
3	42	3.69	.99	1.21
4	64	2.42	1.05	1.28
5	90	1.72	1.10	1.35
5.70	110.58	1.402	1.130	1.383
5.73	111.51	1.390	1.132	1.386
5.74	111.82	1.386	1.133	1.387 ← Min. Allow. Depth for unlined
5.75	112.13	1.382	1.133	1.387 channel = 5.74'

5.74 + 8 = .7175

$S = \left(\frac{Qn}{b^{8/3}}\right)\left(\frac{1}{K'}\right)^2 = \left(\frac{155 \times .030}{256}\right)^2 \cdot .47925 = .000158$ = Max. Allow. Slope for unlined channel

Check $Q_{100/50} = 250$ and $Q_{100} = 185$

$b = 8$ $n = .030$ $z = 2$ $S = .000158$

$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{.03\,Q}{256 (.000158)^{1/2}} = .009323$

$Q = 185$ $K' = 1.725$ $D = 8 \times .779 = 6.23$

$Q = 250$ $K' = 2.331$ $D = 8 \times .899 = 7.15$

Find Min. Slope for 8' deep channel

$S = \left(\frac{Qn}{b^{8/3}}\right)^2 \left(\frac{1}{K'}\right)^2$

For $Q = 185$ try $D = 7$ $\frac{D}{b} = .875$ $S = \left(\frac{185 \times .03}{256}\right)^2 .203 = .0000795$

Check $Q = 250$ and 185 for $S = .0001$ $b = 8$ $n = .030$ $z = 2$

$K' = \frac{.03\,Q}{256 (.0001)^{1/2}} = .011719\,Q$

$Q = 185$ $K' = 2.168$ $D = 8 \times .966 = 6.93$ $6.93 + 1 = 7.93 < 8$

Use $b = 8$, $D = 8$, $z = 2$, $S = .0001$ No Lining

	$Q_{100/80}$	Q_{100}	Q_{50}
REACH 2	1000 cfs	730	510
REACH 1	250	185	155
REACH 1A	750	545	355

Find min. slope for $b=8$, $z=2$, 8' max. channel depth

$S=\left(\frac{Qn}{b^{8/3}k_1}\right)^2$

$Q=750$ $D_{max}=8$ $\frac{D}{b}=1$ $S=\left(\frac{750\times.03}{256\times2.79}\right)^2=.000864$

$Q=545$ $D_{max}=7$ $\frac{D}{b}=.875$ $S=\left(\frac{545\times.03}{256\times2.22}\right)^2=.000828$

Check $S=.001$ for tractive force for Q_{50}

$K'=\frac{Qn}{b^{8/3}S^{1/2}}=\frac{355\times.03}{256\times.03162}=1.316$ $D=8\times.6865=5.49$

$\frac{b}{y}=\frac{8}{5.49}=1.46$ $\tau=.86\,w_y S=.86\times62.4\times5.49\times.001=.29$ psf

Safe for PI ≥ 7 and then some

Use $S=.001$

REACH 2 510
REACH 1 −155
REACH 1A 355 cfs = Q_{50}

$Q=355$ $n=.030$ $b=8$ $z=2$ $\quad S=\left(\frac{Qn}{b^{8/3}}\right)^2\left(\frac{1}{K'}\right)^2=.001731\left(\frac{1}{K'}\right)^2$

D	$\frac{D}{b}$	$\left(\frac{1}{K'}\right)^2$	S	$\frac{b}{y}$	k	T=62.4kys	
8	1	.112	.000194	1	.81	.08	
7	.875	.203	.000351	1.14	.82	.13	
6	.75	.396	.000685	1.3	.84	.22	
5	.625	.861	.001490	1.6	.87	.40	
4.4	.55	1.47	.002545	1.8	.88	.61	
4.3	.5375	1.6125	.002791	1.9	.89	.67	
4.28	.535	1.645	.002847	1.9	.89	.68	PI ≥ 7
4.24	.53	1.71	.002960	1.9	.89	.70	
4.22	.5275	1.745	.003021	1.9	.89	.71	PI ≥ 10

Use $S_{max}=.0028$

For $S=.0028$ $Q=350$ $n=.030$ $b=8$ $z=2$

$K'=\left(\frac{750\times.03}{256\times.0028^{1/2}}\right)=1.661$ $\quad D=8\times.7662=6.13$

$A=124.19$ $V=6.04$ $h_v=.57$ $\quad D+h_v=6.61$

Find Lengths of Transitions to $b=8'$ $z=0$

$4\times6.13+8=32.52'$ $\quad \frac{32.52-8}{2}=12.26'$

$\frac{12.26}{\tan 30^\circ}=21.2'$ $\quad \frac{12.26}{\tan 22.5^\circ}=29.6'$

$Q = 750 \quad n = .013 \quad S = .212$

$$d^{8/3} = \frac{Qn}{K' S^{1/2}} = \frac{750 \times .013}{.498 \times .4604} = 42.5 \qquad d = 4.08$$

Assuming $\frac{D}{d} = .94 \qquad A = .7606 d^2$

Find Slope for 48"ϕ RCP $\quad d = 4 \quad d^{8/3} = 40.3 \quad A = 12.26^{\square'}$

$$S = \left(\frac{Qn}{K' d^{8/3}}\right)^2 = \left(\frac{750 \times .013}{.498 \times 40.3}\right)^2 = .236$$

$V = 61.17$ fps $\quad h_v = 58.1'$

$$K' = \frac{Qn}{d^{8/3} S^{1/2}} = \frac{750 \times .013}{d^{8/3} (.212)^{1/2}} = \frac{9.75}{.4604 d^{8/3}} = \frac{21.18}{d^{8/3}}$$

d	$d^{8/3}$	K'	$\frac{D}{d}$	D	c	A	V	h_v	$D+h_v$
4	40.3	.5256							
4.5	55.2	.3837	.6946	3.13	.5821	11.79		63.61	
5	73.1	.2897	.5739	2.87	.4054				
5.5	94.3	.2246	.4907	2.70	.3899				
6	119	.1780	.4301	2.58	.3280	11.63		64.49	

WE DO NOT HAVE THE HEAD AVAILABLE FOR FULL OPEN CHANNEL FLOW. INVESTIGATE CLOSED CHANNEL FLOW

$$S = 4.66 \left(\frac{Qn}{d^{8/3}}\right)^2 = 4.66 \left(\frac{750 \times .013}{d^{8/3}}\right)^2 = \frac{443}{(d^{8/3})^2}$$

d	A	V	h_v	$d^{8/3}$	S
5.5	23.76	31.57	15.48		
6	28.27	26.53	10.93	119	.031283
6.5	33.18	22.60	7.93	147	.020501
7	38.48	19.49	5.90	179	.013826

$Q_{100/80} = 750 cfs$

Existing 6x6 RCB Under Expressway

IE @ Inlet 206.4 $L = 130$ $S_{invert} = \frac{15}{1.30} = .011538$

IE @ Outet 204.9

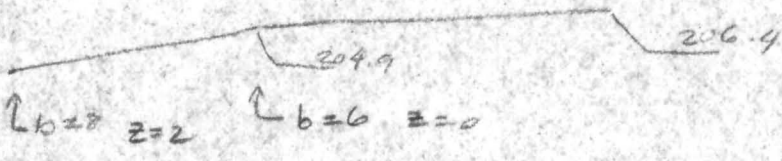
Try open channel flow:

$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{750 \times .014}{119 \times .011538^{1/2}} = .8214$ For $Z=0$, $\frac{D}{b} = 1.1216 > 1$

Therefore assume flowing full $A = 36$ $P = 24$ $R = 1.5$

$S = \left(\frac{Qn}{1.486 AR^{2/3}}\right)^2 = \left(\frac{750 \times .014}{1.486 \times 36 \times 1.310}\right)^2 = .022449$ $V = \frac{750}{36} = 20.83$ $h_v = 6.74$





At outlet $b = 6$ $z = 0$ $Q = 750$

For Min Energy $b = 6$ $D = 7.86$ $V = 15.90$ $h_v = 3.93$ $D + h_v = 11.79$

$(6.74 - 3.93).75 = 2.11 = $ Exit Loss

Outlet: IE = 204.9

+ 7.86

HGL 212.76

+ 3.93

Outside EGL 216.69

216.69

2.11

218.80 EGL inside

6.74

212.06 HGL inside

Existing 6x6 RCB Under Expressway

At inlet: 218.80 EGL @ outlet
$h_f = 130 \times .02249 =$ 2.92
221.72 EGL @ inlet inside

Depth @ Inlet = 16.13' b=6 V=7.75 h_v=.93
Entrance Loss = (6.74 - .93) .30 = 1.74

EGL inside inlet	221.72	
	1.74	
EGL outside inlet	223.46	
	.93	
HGL " "	222.53	This higher than the highway b.f
IE " "	16.13	beyond the scope of work
	206.40	

Outlet of Downstream Transition:

at upstream end D+h_v = 11.79
For canal D/s assume b=8 D=8 z=2
A=192 V = 750/192 = 3.91 h_v=.24
For a straight line transition the transition loss = (3.93 - .24) .3 = 1.11

Neglecting friction loss:

EGL U/s	216.69	
Transition Loss	1.11	
EGL D/s	215.58	
	.29	
HGL	215.34	207.34
	8	-204.9
IE	207.34 > 204.9	2.44

For a positively draining invert we will always have a jump as long as the D/s depth is less than about 10.4' (8+2.44 = 10.44).

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BY AHH DATE 12-20-69 SUBJECT REACH 1-4 SHEET NO. 240 OF

CHKD. BY DATE Q 50 BACKWATER ANALYSIS JOB NO. 13.17

STA	D	A	V	h_v	IE	HGL	EGL	$\frac{D}{b}$	$(\frac{1}{k'})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
18+00	3.05	43.01	8.25	1.06	188.51	191.56	192.62	.38125	6.4225	.002421			
											.004053	25	.10
18+50	3.37	49.67	7.15	.79	188.56	191.93	192.72	.42125	4.33	.001632			
											.003177	25	.08
19+00	3.45	51.41	6.91	.74	188.61	192.06	192.80	.43125	3.94	.001485			
											.002903	25	.07
19+50	3.49	52.28	6.79	.72	188.66	192.15	192.87	.47625	3.7625	.001418			
								$\bar{Y}=.85\times62.4\times3.49\times(3.7625\times.001418)=1.21$			.002758	25	.07
20+00	3.54	53.38	6.65	.69	188.71	192.25	192.94	.4425	3.553	.001340			
											.002606	25	.07
20+50	3.59	54.50	6.51	.66	188.76	192.35	193.01	.04875	3.3575	.001266			
								$\bar{Y}=.85\times62.4\times3.59\times(3.3575\times.001331)=1.11$ PSF				25	
21+00					188.81								
												25	
21+50					188.86								

18+00	3.05	43.01	8.25	1.06	188.51	191.56	192.62	.38125	6.4225	.011447	.014912	6	.37
18+50	3.99	63.76	5.57	.48	188.52	192.51	192.99	.49375	2.1925	.007775			
								$\bar{Y}=.85\times62.4\times3.99\times(.007775)=.1645=.206816$				25	.17
19+00	4.22	69.32	5.12	.41	188.73	192.76	193.16	.5275	1.7455	.003021			
								$\bar{Y}=.85\times62.4\times4.22\times.003021=.1676$ PSF					
19+50					188.94								

18+00	3.05	43.01	8.25	1.06	188.51	191.56	192.62	.38125	6.4225	.002421			
											.002457	25	.10
18+50	3.48	52.06	6.82	.72	188.52	192.00	192.72	.435	3.81	.001436			
											.002054	25	.07
19+00	3.62	55.17	6.43	.64	188.53	192.15	192.79	.4525	3.245	.001233			
											.002033	25	.06
19+50	3.71	57.24	6.21	.60	188.54	192.25	192.85	.46275	2.945	.001110			

WE CANNOT STOP USING UNTIL $\bar{Y} \leq .67$ PSF FOR $n=.030$

∴ TRY A RECTANGULAR OPENING

$Q=355$ $n=.030$ $b=8$ $Z=2$ $S=.001131\left(\frac{1}{k'}\right)^2$ $k_c' = \frac{Q}{b^{5/2}} = \frac{355}{181.02} = 1.961$ $D_c = 8\times.3801 = 3.05$

$n=.014$ $b=8$ $Z=2$ $S=.040377\left(\frac{1}{k'}\right)^2$

STA	b	Z	n	D	A	V	hv	IE	HGL	EGL	D/b	$(\frac{1}{K'})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH_f
18+00	12	0	.014	3.01	36.12	9.83	1.50	188.51	191.52	193.02						
18+00	12	2	.014	4.71	100.89	3.52	.19	188.51	193.22	193.41	.3925	5.73	.000296			
								(1.50−.19) 3 = .39		191.52+.39=193.91				.000706	25	.02
18+50	8	2	.014	4.60	79.12	4.49	.31	188.56	193.16	193.47	.575	1.22	.000460			
								(.31−.19).3 = .04		193.41+.04=.02 = 193.47						
18+50	8	2	.030	4.60	79.12	4.49	.31	188.56	193.16	193.47	.575	1.22	.002112			
				$\frac{b}{y}$ = 1.7				$T = .85 \times 62.4 \times 4.6 \times .002112 = .53$ PSF								

$Q = 355$ $b=8$ $n=.014$ $S = .000377\left(\frac{1}{K'}\right)^2$ $n=.030$ $S = .001731\left(\frac{1}{K'}\right)^2$

$K_c' = \frac{Q}{b^{8/3}} = \frac{355}{498.8} = .7117$ $D_c = 12 \times .2506 = 3.01$

$b=12$ $n=.014$ $S = .000043\left(\frac{1}{K'}\right)^2$

THERE BEING NO TRACTIVE FORCE PROBLEM FOR Q_{50}, LET US CHECK $Q_{100/50}$

STA	b	Z	n	D	A	V	hv	IE	HGL	EGL	D/b	$(\frac{1}{K'})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH_f
18+00	12	0	.014	4.95	59.40	12.63	2.48	188.51	193.46	195.94						
18+00	12	2	.014	7.94	221.37	3.39	.18	188.51	196.45	196.63	.6617	.67686	.000131			
								(2.48−.18).3 = .69		195.94+.69 = 196.63				.000337	25	.01
18+50	8	2	.014	7.85	186.05	4.03	.25	188.56	196.41	196.66	.98125	.12225	.000206			
								(.25−.18).3 = .02		196.63+.02+.01 = 196.66						
18+50	8	2	.030	7.85	186.05	4.03	.25	188.56	196.41	196.66	.98125	.12225	.000948	.001588	25	.05
19+00	8	2	.040	7.85	186.05	4.03	.25	188.61	196.46	196.71	.98125	.12225	.001240			

$Q = 750$ $n=.014$ $b=12$ $S = .000193\left(\frac{1}{K'}\right)^2$; $b=8$ $S = .001682\left(\frac{1}{K'}\right)^2$; $n=.030$ $b=8$ $S = .007725\left(\frac{1}{K'}\right)^2$

$K_c' = \frac{Q}{b^{8/3}} = \frac{750}{498.8} = 1.5035$ $D = 12 \times .4126 = 4.95$

BY AWJ DATE 1-21-69 SUBJECT REACH 1A — 5' DROPS — STRAIGHT DROP SHEET NO. 242 OF
CHKD. BY DATE JOB NO. 1317

REF.: Chow, "Open-Channel Hydraulics", Pp. 423-425

$Q_{100/50} = 750$ cfs $\quad q = \frac{750}{12} = 62.5 \quad h = 5'$

"Drop Number" $= D = \frac{q^2}{gh^3} = \frac{62.5^2}{32.2 \times 5^3} = .9705$

$L_d = 4.30 h D^{.27} = 21.5 \times .9920 = 21.33$

$y_p = h D^{.22} = 5 \times .9934 = 4.967$

$y_1 = .54 h D^{.425} = 2.7 \times .9874 = 2.666$

$y_2 = 1.66 h D^{.27} = 8.3 \times .9920 = 8.234$

$Z_1 = \frac{V_1}{\sqrt{g D_1}} \qquad V_1 = \frac{q}{D_1} = \frac{62.5}{2.666} = 23.4$ fps

$Z_1 = \frac{23.4}{\sqrt{32.2 \times 2.666}} = \frac{23.4}{\sqrt{85.8}} = \frac{23.4}{9.27} = 2.52$

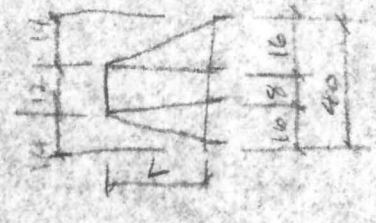
REF.: USBR, "Hydr. Design of Stilling Basins & Energy Diss.", Fig. 6 & 7

Fig. 6 for $Z_1 = 2.5 \quad L = 15 D_1 = 15 \times 2.666 = 39.99$
Fig. 7 for $Z_1 = 2.5 \quad L = 5 D_2 = 5 \times 8.234 = 41.17$

$L_d + L = 21.33 + 41.17 = 62.50$

Use $b = 12$ for 25', Then transition to $b = 8$ for 45'
for 70' of lining

Upstream Transitions:



$\frac{14}{L} = \tan 30° \quad L = 24.3$ Min.

Actually the transition is less abrupt
Use 30'

STA	n	b	z	D	A	V	hv	IE	HGL	EGL	$\frac{D}{b}$	$\left(\frac{1}{K'}\right)^2$	S	S_1+S_2	$\frac{L}{2}$	ΔH
7+00	.014	22	0	2.01	44.22	8.03	1.00	0	2.01	3.01	.09126	1654	.002828	.005249	10	.05
7+20	.014	8	2	3.05	43.00	8.26	1.06	0.02	3.07	4.13	.38125	6.4225	.002421			

$.5(1.06-1.00)=.03$ $3.01+.03+.05=3.09<4.13$ ∴ CONTROL IS @ START OF TRANS.

7+20	.030	8	2	3.05	43.00	8.26	1.06	0.02	3.07	4.13	.38125	6.4225	.011117			

$Q_{50}=355$ cfs $b=22$ $n=.014$ $S=.00000171\left(\frac{1}{K'}\right)^2$ $b=8$ $n=.014$ $S=.000377\left(\frac{1}{K'}\right)^2$

$b=8$ $n=.030$ $S=.001731\left(\frac{1}{K'}\right)^2$ $K_c'=\frac{Q}{b^{5/2}}=\frac{355}{2270}=.1564$ $D_c=22\times.09126=2.01'$

$K_c'=\frac{Q}{b^{5/2}}=\frac{355}{181}=1.961$ $D_c=8\times.3807=3.05$

Check Tractive Force @ Sta 0+20

$\frac{b}{y}=\frac{8}{3.05}=2.05$ $\tau=.90\,w\,y\,S=.9\times62.4\times3.05\times.011117=1.90$ PSF

0+00	.014	22	0	2.01	44.22	8.03	1.00	1.45 (−.02)	3.46	4.46	.09126	1654	.002828	.003436	10	.03
0+20	.014	8	2	4.30	71.38	4.97	.38	0.00	4.30	4.68	.5375	1.6125	.000608			

$.3\,\Delta hv=.3(1.00-.38)=.19$ $4.46+.19+.03=4.68$

0+20	.030	8	2	4.30	71.38	4.97	.38	0.00	4.30	4.68	.5375	1.6125	.002791			

$\frac{b}{y}=1.86$ $\tau=.89\times62.4\times4.3\times.002791=.67$ PSF OK for PI ≥ 7

$1.45+.02=1.47$, Use 18" high weir

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BY AMW DATE 2-13-69 SUBJECT Baffled Apron Drop

CHKD. BY ..... DATE ..... Backwater for Q_{50}

SHEET NO. 243 OF .....

JOB NO. 1317

STA	n	b	Z	D	A	V	h_v	IE	HGL	EGL	$\frac{D}{b}$	$(\frac{1}{K})^2$	S	S_1+S_2	$\frac{L}{2}$	ΔH
2+00	.014	22	0	3.31	72.82	10.30	1.65	1.48	4.79	6.44	.1503	356	.002720	.003263	10	03
+20	.014	8	2	6.29	129.45	5.79	.52	0	6.25	6.81	.78625	.32275	.000543			

$.3\Delta h_v = .3(1.65-.52) = .34$ $\quad 6.44+.34+.03 = 6.81$

+20	.030	8	2	6.29	129.45	5.79	.52	0	6.29	6.81	.78625	.32275	.002493			

$Q_{100/80} = 750\ cfs$ $\quad b=22\ \ n=.014\ \ S=.00000964\left(\frac{1}{K}\right)^2$

$b=8\ \ n=.014\ \ S=.001682\left(\frac{1}{K}\right)^2$ $\quad b=8\ \ n=.030\ \ S=.007725\left(\frac{1}{K}\right)^2$

$K_c' = \frac{Q}{b^{5/2}} = \frac{750}{22^{5/2}} = \frac{750}{2270} = .3304$ $\quad D_c = 22\times.1503 = 3.31$ $\quad A=72.82$ $\quad V=10.30$ $\quad h_v=1.65$ $\quad D+h_v = 4.96$

$K_c' = \frac{Q}{b^{5/2}} = \frac{750}{8^{5/2}} = \frac{750}{181} = 4.144$ $\quad D_c = 8\times.5646 = 4.52$ $\quad A=77.02$ $\quad V=9.74$ $\quad h_v=1.47$ $\quad D+h_v = 5.99$

Check Tractive force: $\frac{b}{y} = 1.29$ $\quad \tau = .84\ w\ y\ S = .84\times62.4\times6.29\times.002493 = .82\ PSF$

For PI less than 20 there will be damage but this is allowable for any storm beyond 50 years according to the District Design Standards.

Section 3

South Unit

Final:

Estimate

Comparisons

Calculations

McCREARY · KORETSKY · ENGINEERS

BY AWW DATE 2-1-69 SUBJECT TEXT TABLE 2 SHEET NO. 302 OF
CHKD. BY DATE SOUTH UNIT JOB NO. 1317

ITEM	PRICE	REACHES 6-9		REACHES 1-5		REACHES 10-15		TOTAL SOUTH UNIT		SUM OF EXTENSIONS
Clearing	$300/A	8 A	$2,400	15 A	$4,500	5 A	$1,500	28 A	$8,400	$8,400
Clearing	600/A	0 A	0	0 A	0	3 A	1,800	3 A	1,800	1,800
Exc.	1.00	58,207 CY	58,207	37,395 CY	37,395	39,259 CY	39,259	134,861 CY	134,861	134,861
Emb	0.40	10,911 CY	4,364	33,143 CY	13,257	7,296 CY	2,918	51,350 CY	20,540	20,539
Conc. PCCP	50.00	0 CY	0	120 CY	6,000	40 CY	2,000	160 CY	8,000	8,000
Str. PCC	100.00	250 CY	25,000	160 CY	16,000	100 CY	10,000	510 CY	51,000	51,000
4" ϕ CMP	15.00	60 LF	900	198 LF	2,970	163 LF	2445	421 LF	6,315	6,315
4" ϕ RCP Conc.	50.00	0 Ea	0	3 Ea	150	0 Ea	0	3 Ea	150	150
4" ϕ RCP Conc. Jack	240.00	0 LF	0	0 LF	0	120 LF	28,800	120 LF	28,800	28,800
Bridges	10,000.00	1 Ea	10,000	1 Ea	10,000	0 Ea	0	2 Ea	20,000	20,000
			$100,871		$90,272		$88,722		$279,866	$279,865
25%			25,218		22,568		23,181		69,967	69,967
			$126,089		$112,840		$110,903		$349,833	$349,832
ROW	$3,000.00	8.30 A	24,900	14.91 A	44,730	0 A	0	23.21 A	69,630	69,630
ROW	8,000.00	0 A	0	0 A	0	7.76 A	62,080	7.76 A	62,080	62,080
			$150,989		$157,570		$172,983		$481,543	$481,542
Construction			$100,900		$90,300		$88,700		$279,900	
Contingencies			25,200		22,600		22,200		70,000	
Right of Way			24,900		44,700		62,100		131,700	
Total			$151,000		$157,600		$173,000		$481,600	

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 4-30-65 SUBJECT REACH 5 SHEET NO. 303 OF
CHKD. BY DATE 2ND PROG. RPT. VS. BLOOMFIELD JOB NO. 1317
D/S US101 CULVERT ONLY

ITEM		2ND PROG. RPT.		BLOOMFIELD	
Excavation	$1.00	92,400 CY	$92,400	109,700 CY	$109,700
Embankment	0.40	44,100 CY	17,640	21,700 CY	8,680
Sacked Concrete Riprap	50.00	100 CY	5,000	100 CY	5,000
Structural Concrete	100.00	191 CY	19,100	125 CY	12,500
24"ϕ CMP	15.00	318 LF	4,770	180 LF	2,700
84"ϕ RCP, Jacked	240.00	0 LF	0	200 LF	48,000
24"ϕ Flap Gates	50.00	3 Ea	150	3 Ea	150
Bridges	10,000.00	2 Ea	20,000	1 Ea	10,000
			$159,060		$196,730
+25%			39,765		49,183
			$198,825		$245,913
R.O.W.	3,000.00	23.21 A	69,630	13.44 A	40,320
			$268,455		$286,233

"FINAL" COMPARISON

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 1-27-49 SUBJECT REACHES 3, 4, 5 SHEET NO. 369 OF

CHKD. BY DATE JOB NO. 1317

Excavation *	134,900 CY	$ 1.20	$ 161,880
Embankment *	51,400 CY	0.80	41,120
Lining Concrete	261 CY	60.00	15,660
Structural Concrete	550 CY	90.00	49,500
24"ϕ C.M.P.	200 LF	15.00	3,000
72"x44" C.M.P.A.	35 LF	40.00	1,400
84"ϕ R.C.P., Jacked	120 LF	240.00	28,800
24"ϕ Flap Gates	3 Ea	50.00	150
Bridges	2 Ea	10,000.00	20,000
			$ 321,510
+25%			80,378
			$ 401,888
R.O.W.	32 A	$ 3,000.00	96,000
			$ 497,888

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 1-27-69 SUBJECT REACHES 3, 4, 5 SHEET NO. 305 OF
CHKD. BY DATE NOMINAL SECTION JOB NO. 1317
CUT & FILL

B	b	D	Z	d	STA	CUT	FILL	CLAY LINING
15'	14'	11'	2'	11'	0+50	396 □'	0 □'	
		10.9		8.0	2	240	121	
		10.8		7.8	4	231	126	
		10.74		6.6	6	180	193	
		10.72		4.6	8	107	333	
		10.70		5.5	10	138	264	
		10.68		5.6	12	138	263	
		10.66		4.3	14	97	353	
		10.64		3.5	16	74	418	
		10.62		3.5	18	74	416	
		10.60		3.5	20	74	415	
		10.58		5.0	22	120	884	
		10.56		5.4	24	134	261	
		10.54		5.0	26	120	289	
15	8	10.2	2	8.6	28	217	58	
				9.0	30	234	42	
				10.0	32	280	6	
				10.1	34	286	6	
				10.0	36	280	6	
				9.6	38	261	19	
				10.0	40	280	6	
				10.6	42	310	0	
				11.2	44	340	0	
				11.0	46	330	0	
				11.6	48	362	0	
				11.8	46+45	373	0	
15	8	10	0	11.8	48+35	94	0	
				12.0	49+95	96	0	
15	10	8.1	2	5.5	50+35	116	105	
				6.0	52	132	81	
				6.6	54	153	54	
				7.2	56	176	30	0
				7.4	58	184	23	40
				8.1	60	212	0	58
				9.6	62	280	0	
				10.0	64	300	0	
				10.5	66	326	0	

37,895 CY
33,143 CY

1,009,653 CF = CUT
894,875 CF = FILL

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 1-27-69 SUBJECT REACHES 3,4,5 SHEET NO. 306 OF
CHKD. BY DATE NORMAL SECTIONS JOB NO. 1217
CUT & FILL

B	b	D	Z	d	STA	CUT	FILL	CLAYLINER
				10.9	68	347	0	76
				11.3	70	368	0	
				11.9	72	379	0	
				11.2	74	363	0	85
				11.4	76	379	0	
				11.5	78	380	0	94
				12.5	80	438	0	
				13.9	82	493	0	
				13.5	84	500	0	103
				12.9	86	462	0	
				13.4	87+80	493	0	103/0
15	12	10	0	14.5	88+20	174	0	
				16.3	85+80	196	0	
				16.0	90+00	192	0	
				15.0	92+30	180	0	
15	16	8	2	9.9	92+70	343	0	0/56
				8.6	94	286	0	66
				8.3	96	271	0	
				8.4	98	276	0	
				8.2	100	266	0	
				8.0	102	256	0	61
				8.5	104	281	0	
				8.7	106	291	0	
				8.7	108	291	0	66
				8.5	109	281	0	
15	8	0	2	8.2	110	266	0	
				8.0	112	256	0	
				8.0	114	256	0	61
				8.2	116	266	0	
				8.2	118	266	0	
				8.0	120	256	0	61
				9.4	122	327	0	75
				9.7	123+40	343	0	77/0
15	8	8	0	10.0	123+80	360	0	
						3134,503 CF	939,720 CF	446,785 CF
						118,315 CY	34,804 CY	16,540 CY

Cut = 1,321,855 CF = 48,957 CY + 9,250 = 58,207 CY
Fill = 44,845 CF = 1,661 CY + 9,250 = 10,911 CY
Comp = 249,740 CF = 9,250 CY
Cut = 86,295 CF = 3,196 CY + 7,296 = 39,259 CY
Fill = 0 CF = 0 CY + 7,296 = 7,296 CY
Comp = 197,005 CF = 7,296 CY

34609
16546
51350 CY
← Gross Emb.

118315
16546
134861 CY
← Gross Emb.

Lining Concrete

0+00	$\sqrt{5} \times 11$	= 24.6	24.6 × 50 =	1230 sq ft
0+50	$\sqrt{5} \times 11$	= 24.6		
	$\sqrt{5} \times 11 + 14$	= 38.6	$\frac{38.6+87.8}{2} \times 50$ =	3160
1+00	$(\sqrt{5} \times 11)3 + 14$	= 87.8		
1+20	$(\sqrt{5} \times 11)3 + 14$	= 87.8	87.8 × 20 =	1756
			61460 sq ft × $\frac{1}{3}$ × $\frac{1}{27}$ =	76 CY
18+45	$(\sqrt{5} \times 8.5)2 + 8$	= 46.0		
48+45	$2 \times 8.5 + 8$	= 25.0	$\frac{25+46}{2} \times 50 \times \frac{1}{2} \times \frac{1}{27}$ =	33 CY
49+95	$2 \times 14.2 + 8$	= 36.4	$\frac{36.4+46.2}{2} \times 40 \times \frac{1}{2} \times \frac{1}{27}$ =	31 CY
50+35	$(\sqrt{5} \times 8.1)2 + 10$	= 46.2		
87+80	$(\sqrt{5} \times 8.1)2 + 10$	= 46.2	$\frac{46.2+28.2}{2} \times 50 \times \frac{1}{2} \times \frac{1}{27}$ =	34 CY
58+80	$8.1 \times 2 + 12$	= 28.2		
92+30	$10.3 \times 2 + 12$	= 32.6	$\frac{32.6+51.8}{2} \times 40 \times \frac{1}{2} \times \frac{1}{27}$ =	31 CY
92+70	$(\sqrt{5} \times 8)2 + 16$	= 51.8		
123+60	$(\sqrt{5} \times 8)2 + 8$	= 43.8	$\frac{43.8+23}{2} \times 40 \times \frac{1}{2} \times \frac{1}{27}$ =	25 CY
124+00	$8 \times 2 + 7$	= 23		
125+20	$8 \times 2 + 7$	= 31	$\frac{31+53.4}{2} \times 40 \times \frac{1}{2} \times \frac{1}{27}$ =	31 CY
125+60	$(\sqrt{5} \times 3)2 + 46$	= 53.4		261 CY

Structural Concrete

8×8×100' R.C.B.	100 × 1.03 =	103 CY	} See C.L.F. Div. Hwys Std Single R.C.B. - D80
12×7×400 R.C.B.	400 × 1.03 =	412 CY	
Headwalls for 8×8 R.C.B.	Say	20	160 × 1.03 = 165 CY by District
" " 12×7 R.C.B.	"	20	240 × 1.03 = 247 CY by Div. Hwys.
" " 72×44 CMPA	"	10	412
" " 84"ϕ R.C.P.	"	15	
		550	

McCREARY · KORETSKY · ENGINEERS

BY AWK DATE 1-2-69 SUBJECT REACH 5 SHEET NO. 308 OF

CHKD. BY DATE Backwater Analysis JOB NO. 1317

$Q = 1200$ $b = 14'$ $z = 2$ $n = .030$ $S = \frac{Qn}{1.49 A R^{2/3}}$ $\left(\frac{1}{k}\right)^2 = .000997 \left(\frac{1}{k}\right)^2$

STA.	I.E.	D	H.G.L.	$A = 14D + 2D^2$	$V = \frac{1200}{A}$	h_v	E.G.L.	D/b	$\left(\frac{1}{k}\right)^2$	$S = .000997 \left(\frac{1}{k}\right)^2$	$S_1 + S_2$	$\frac{\Delta L}{2}$	ΔH
4+00	133.01	9.50	142.203	324.48	3.12	0.15	142.95	.7714	.351	.000350	.000710	200	0.19
4+00	132.20	10.74	142.94	368.03	3.15	0.15	143.09	.767	.358	.000360	.000727	200	0.15
3+00	132.40	10.68	143.08	367.61	3.14	0.16	143.24	.763	.364	.000367	.000742	200	0.15
2+00	132.60	10.63	143.23	364.81	3.20	0.16	143.39	.759	.376	.000385	.000757	200	0.15
1+00	132.80	10.58	143.38	361.99	3.23	0.16	143.54	.755	.383	.000392	.000772	200	0.15
0+00	133.00	10.53	143.53	359.12	3.25	0.16	143.69	.7521	.391	.000399	.000787	200	0.16
1+00	133.20	10.48	143.68	356.27	3.28	0.17	143.85	.7486	.399	.000397	.000802	200	0.16
[illegible]	133.40	10.44	143.84	354.15	3.30	0.17	144.01	.7457	.406	.000405	.000814	130	0.11
0+00	133.60	10.42	143.95	353.05	3.31	0.17	144.12	.7443	.410	.000409	.000823	25	0.02
1+00	133.85	9.87 (1)	143.63	337.64	6.75	0.71	144.34	5483	901	.000514		0	0
"	"	8.00 (2)	143.77	300.52	11.99	2.21	145.98 (3)	1	[k=403]	.004521	.005855	10	0.04
1+00	133.96	" (2)	"	"	"	"	146.07	"	"	"		0	0
"	"	12.46 (1)	146.03	229.28	5.35	0.44	146.47 (4)	.6172	4.940	.002240	.002520	20	0.05
1+00	139.9334	7.08 (3)	145.91	191.20	6.28	0.61	146.52	.1975	.11325	.002240	.004480	215	0.96
0+00	139.884	7.08	146.87	"	"	0.61	147.48	"	"	.002240	.004480	200	0.90 → D = 7.98
		7.03	147.26	"	"	0.61	147.37	"	"	"	.004487	200	0.89 → D = 7.58
0+00	139.776	7.29	147.17	191.00	6.28	0.61	147.38	.9958	.1126	.002229	.004442	200	0.89
1+00	140.664	8.00	148.66	192.00	6.25	0.61	149.27	1	.112	.002215	.004430	200	0.89
2+00	141.55 (2)	8.00	149.54	"	"	0.61	150.16	"	"	"			

FINAL PROFILE

$\frac{(1200 \times .03)^2}{1.49^2 \times 14^2 \times 3.28^{4/3}} \left(\frac{1}{k}\right)^2 = .000997 \left(\frac{1}{k}\right)^2$

(1) $b = 8'$ $z = 2$ $A = 6D$ $S = \left(\frac{Qn}{b^{8/3}}\right)^2 \left(\frac{1}{k}\right)^2 = \left(\frac{1200 \times .014}{2290}\right)^2 \left(\frac{1}{k}\right)^2 = .000057 \left(\frac{1}{k}\right)^2$

(2) $2 - 8'\phi$ $S = \left(\frac{Qn}{k' d^{8/3}}\right)^2 = \left(\frac{600 \times .013}{256\, k'}\right)^2 = \frac{.000725}{k'^2}$

(3) $\Delta h_v = 2.21 - 1.17 = 2.04$ $.9 \Delta h_v = 1.84$ $144.14 + 1.84 = 145.98$

(4) $\Delta h_v = 2.21 - 0.61 = 1.60$ $0.25 h_v = 0.40$ $146.07 + .40 = 146.47$

(5) $b = 8'$ $z = 2$ $S = \left(\frac{Qn}{b^{8/3}}\right)^2 \left(\frac{1}{k}\right)^2 = \left(\frac{1200 \times .03}{256}\right)^2 \left(\frac{1}{k}\right)^2 = .013775 \left(\frac{1}{k}\right)^2$

STA	I.E.	b	D	Z	H.G.L.	A	V	h_v	E.G.L.	$\frac{D}{b}$	$(\frac{1}{K})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
24+00	133.20	14	10.48	2	142.68	366.38	3.28	0.17	145.85 ①	.7486	.399	.000397			
													.000799	100	0.08
26+00	133.80	14	10.46	2	142.76	365.36	3.29	0.17	143.93	0.7471	.403	.000402			
													.001199	100	0.12
28+00	133.73	8	10.04	2	143.77	251.92	4.26	0.28	144.05 ②	1.254	.0403	.000797			
													.001825	200	0.37
32+00	134.53	8	9.09	2	144.08	256.04	4.09	0.24	144.42 ③	1.1362	.0526	.001028			
													.002314	200	0.46
36+00	135.45	8	9.03	2	144.48	235.32	5.10	0.40	144.88 ②	1.28375	.06504	.001286			
													.002824	200	0.56 → D=5.63
													.002832		0.57 → D=5.68
40+00	136.31	8	8.68	2	144.99	220.12	5.45	0.46	145.85 ②	1.085	.0378	.001538			
			8.69			219.70	5.46	0.46	144.29	1.2375	.0382	.001544			
													.003202	200	0.66
44+00	137.17	8	8.43	2	145.60	209.57	5.73	0.51	146.11 ②	1.05375	.08871	.001754			
													.003648	222.5	0.82
48+45	138.127	8	8.25	2	146.38	202.13	5.94	0.55	146.93 ②	1.03125	.0978	.001934			
"	"	"	"	2	"	"	"	"	"	③	"	.000421			
													.004213	25	0.23
48+95	138.234	8	9.87	0	146.10	62.90	19.06	5.69	151.79	③ .98375	2.0425	.008792			
"	"	8		0		(5.04-.55).9 = 4.58			146.93 + 4.58 + .23 = 151.74						
													.021412	50	1.07
49+95	138.449	8	6.80	0	145.25	54.44	22.06	7.56	152.81	③ .85	2.93	.012620			
													.012990	20	0.26
50+35	145.85	8	8.49	2	154.34	212.08	5.66	0.50	154.34	③ 1.061	.0860	.000370			
						(7.56-.50).25 = 1.77			152.81 + 1.77 + 0.26 = 154.84						
50+35	"	"	"	"	"	"	"	"	154.84	② "	"	.001701			
87+55	152.174	"	"	"	160.06	"	"	"	161.16	② "	"	.001701			
"	"	"	8.77	"	160.94	223.99	3.78	0.22	"	④ 1.04625	.0726	.000152			
82+60	152.353	10	7.95	0	160.30	79.50	10.05	1.76	162.06	⑤ .795	3.405	.002263			
						(1.76-.22).5 = .77			161.16 + .77 + .13 = 162.06						
"	"	9'φ	7.53	"	159.61	72.04	14.00	3.15	162.76	⑥ .8164	K'=.4713	.004459			
						(3.45-1.76).5 = 1.77			162.06 + 1.77 + 1.13 = 163.96						
30+20	153.08	"	"	"	160.59	"	"	"	164.04	⑥ "	"	.004459			

FINAL PROFILE EXCEPT FOR STATION CHANGES

.003402	1860	6.33, use 6.32
.002422	52.5	0.13
.002714	80	0.21

Q=1200 n=.013

Q=1200 n=.014

Q=841 n=.014

Q=647 n=.013

① L=14 $S=.000797(\frac{1}{K})^2$

② b=2 $S=.019775(\frac{1}{K})^2$

③ b=8 $S=.004309(\frac{1}{K})^2$

④ b=8 $S=.002146(\frac{1}{K})^2$

⑤ b=10 $S=.000653(\frac{1}{K})^2$

⑥ 9'φ $S=\frac{.000797}{(K')^2}$

Check 8'φ D=7.53 $S=\left(\frac{841\times.013}{256\times.495}\right)^2=.007486$ 160.5 − 49' A=49.06 h_v=4.63

REACH 5 BACKWATER ANALYSIS

A.W.H. 1-6-69

309 1317

McCREARY · KORETSKY · ENGINEERS

BY AHK DATE 1-23-89 SUBJECT REACH 5 SHEET NO. 3 OF

CHKD. BY DATE BACKWATER ANALYSIS JOB NO. 1317

STA	n	Z	b	D	A	V	hv	IE	HGL	EGL	D/b	(1/K)²	S	S₁+S₂	ΔL/I	ΔH
18+45.014	2	8	8.25	202.3	5.09	.55	138.127	146.83	146.93	1.03125	.0978	.000421				
														.007321	25	.18
18+95.014	0	8	8.87	70.96	16.91	4.44	138.224	147.10	151.54	1.10875	1.5975	.006880				
					(4.44−.55)·.5 = 1.95			146.93+1.95+.18 = 149.06 < 151.54			DISSIPATOR NEEDED				
														.012760	50	.64
19+35	.014	0	8	8.87	70.96	16.71	4.44	138.934	147.80	152.24	1.10875	1.5975	.006880			
				D₀					151.54+.64 = 152.28 < 152.24							
														.007259	20	.15
19+55	.014	2	10	8.07	210.95	5.63	.50	145.000	153.07	153.57	.807	.2888	.000379			
					(4.44−.50)·.3 = 1.18				152.24+1.18+.15 = FINAL EXCEPT STATIONS CHANGED							
19+35	.030	2	10	8.07	210.95	5.69	.50	145.000	153.07	153.57	.807	.2888	.001739	.003968	1825	1.63
19+00	.030	2	10	8.08	211.37	5.68	.50	145.621	153.70	154.20	.808	.2892	.001729			
18+00	.030	2	10	8.09	211.80	5.67	.50	146.321	154.34	154.84	.809	.2896	.001719	.003968	2000	1.64
17+00	.030	2	10	8.10	212.22	5.65	.50	146.981	155.03	155.53	.810	.2900	.001710	.003968	2000	1.64
16+00	.030	2	10	8.11	212.64	5.64	.49	147.661	155.77	156.26	.811	.2925	.001701	.003968	2000	1.62
17+55	.03	2	10	8.11	212.64	5.64	.49	147.324	159.43	159.92	.811	.2925	.001701	.003902	1077.5	3.507
USE →				8.12	213.07	5.63	.49	151.324	159.44	159.93	.812	.2929	.001682	.003902	1077.5	3.66
17+55	.014	2	10	8.39	224.68	3.77	.22	151.324	159.71	159.93	.839	.3043	.000159	.002402	52.5	.15
18+60	.014	0	10	7.97	747	11.34	2.00	151.503	158.97	160.97	.797	4.052	.002646			
					(2.00−.22)·.5 = .89				159.93+.89+.15 = 160.97							
18+60	.013	10'	7.21	60.59	13.98	3.03	151.503	158.71	161.74	.721	K' = .4027	.003473				
					(3.03−2.00)·.75 = .77				160.97+.77 = 161.74					.006946	80	.56
19+20	.013	10'	7.21	60.59	13.98	3.03	152.063	159.27	162.30	.721	K' = .4027	.003473				
19+20	.014	0	10	9.56	25.00	8.84	1.22	152.003	161.62	162.84	.956	2.119	.001430			
					(3.03−1.22)·.3 = .54				162.30+.54 = 162.84							
19+60	.014	2	16	7.87	249.39	4.80	.36	152.900	162.72	163.13	.4919	2.321	.000296	.001676	20	.03
					(1.22−.36)·.3 = .26				162.84+.26+.03 = 163.13							

Q = 1200 b = 8 n = .014 $S = .004307\left(\frac{1}{K}\right)^2$

Q = 1200 b = 10 n = .014 $S = .001311\left(\frac{1}{K}\right)^2$

Q = 847 b = 10 n = .014 $S = .001853\left(\frac{1}{K}\right)^2$

Q = 1200 b = 16 n = .014 $S = .000106\left(\frac{1}{K}\right)^2$

n = .030 $S = .006020\left(\frac{1}{K}\right)^2$

Q = 847 n = .013 $\phi = 10$ $S = \left(\frac{847 \times .013}{460 \times .0027}\right)^2 = .003473$

n = .030 $S = .000835\left(\frac{1}{K}\right)^2$

STA	n	z	b	D	A	V	hv	E	HGL	EGL	D/6	(1/K)²	S	S1+S2	ΔL/2	ΔH
66+00	.030	2	10	8.11	212.64	5.64	.40	147.661	155.77	156.26	.811	.2825	.0011401	.003402	1090	3.71
57+20	.030	2	10	8.11	212.64	5.64	.49	151.367	159.48	159.97	.811	.2825	.0017001			
57+80	.014	2	10	8.11	212.64	5.64	.49	151.367	159.48	159.97	.811	.2825	.0003720	.004216	25	.11
38+30	.014	0	12	6.96	83.52	14.37	3.21	151.452	158.41	161.62	.58	7.77	.0038496			
12'x7'x400' R.C.B.									(3.21 − .49) · 2 = .54				159.97 + .54 + .11 = 160.62			
32+30	.014	0	12	6.96	83.52	14.37	3.21	152.99	159.95	163.16	.58	7.77	.0038496	.007692	200	1.54
32+70	.014	2	16	7.87	249.79	4.80	.36	155.296	163.17	163.53	.4919	2.321	.0002497	.0040933	20	.08
									(3.21 − .36) · .1 = .29				163.16 + .29 + .08 = 163.53			
32+70	.030	2	16	7.87	249.79	4.80	.36	155.296	163.17	163.53	.4919	2.321	.0011133	.002260	15	.03
33+00	.030	2	16	7.88	250.27	4.79	.36	155.320	163.20	163.56	.4925	2.310	.0011127			
33+00	.030	2	16	7.98	255.04	4.12	.26	155.320	163.30	163.56	.49675	2.1925	.0008118	.001622	400	.65
01+00	.030	2	16	7.99	255.52	4.11	.26	155.960	163.95	164.21	.499375	2.1525	.0008114	.001622	400	.65
09+00	.030	2	16	8.00	256.00	4.10	.26	156.600	164.60	164.86	.5	2.17	.0008003			
09+00	.030	2	16	8.15	265.25	2.66	.11	156.60	164.75	164.86	.509375	2.0125	.0000334	.000676	50	.05
10+00	.030	2	8	8.03	193.20	3.62	.20	156.460	164.71	164.91	.4003	.1102	.0007042	.001496	150	.22
13+00	.030	2	8	8.00	193.00	3.65	.21	156.920	164.92	165.13	1	.112	.0007054	.001551	50	.08
14+00	.030	2	8	7.90	186.02	3.72	.21	157.100	165.00	165.21	.9475	.1185	.0007992	.001609	100	.17
16+00	.030	2	8	7.69	174.29	3.89	.23	157.460	165.15	165.38	.96125	.1341	.0009002	.002019	200	.40
20+01	.030	2	8	7.32	165.72	4.22	.28	158.180	165.50	165.78	.915	.166	.0011117	.002420	180	.43
22+60	.030	2	8	7.08	158.89	4.46	.31	158.828	165.91	166.22	.885	.193	.0012994		USE 44	
23+60	.014	2	8	7.08	158.89	4.46	.31	158.828	165.91	166.22	.885	.193	.0002834	.0006659	20	.13
24+00	.014	0	7	6.77	47.39	19.17	5.39	158.900	165.67	169.06	.3671	2.1274	.0063764		DISSIPATOR NEEDED	
									(3.39 − .31) · .5 = 1.54				166.22 + 1.54 + .13 = 167.89 < 169.06			

D = 12.0
S = .003855
D = 16.0
S = .002618
D = 7.0

FINAL EXCEPT FOR CHANGES IN STATIONS

McCREARY · KORETSKY · ENGINEERS

BY ... DATE 4-23-69 SUBJECT RACHEL ST SHEET NO. 2 OF 2

CHKD. BY ... DATE ... 120"ϕ x 1160' RCP UNDER US 101 JOB NO. 1317

STA	n	z	b	D	A	V	hv	IE	HGL	EGL	D/b	(1/K)²	S	S+S₂	ΔL/2	ΔH
10+60	.030	2	16	7.87	249.79	4.89	.36	154.900	162.77	163.13	.4919	2.321	.001133	.002260	120	.27
13+00	.030	2	16	7.88	250.27	4.79	.36	155.164	163.04	163.40	.4925	2.31	.001127			
13+60	.030	2	16	7.95	255.04	4.12	.26	155.164	163.14	163.40	.49875	2.1925	.000818	.001632	240	.33
17+00	.030	2	16	7.97	255.52	4.11	.26	155.484	163.47	163.73	.499375	2.1825	.000814	.001628	200	.33
17+00	.030	2	16	7.97	255.52	4.11	.26	155.804	163.79	164.05	.499375	2.1825	.000814			
		USE	8.00	256.00	4.10	.26			163.80	164.06	.5	2.17	.001807	.001623	200	.32
25+00	.030	2	16	8.00	256.00	4.10	.26	156.124	164.12	164.38	.5	2.17	.000805	.001618	200	.32
29+00	.030	2	16	8.00	256.00	4.10	.26	156.444	164.49	164.70	.5	2.17	.000809			
29+00	.030	2	16	8.15	263.25	3.66	.11	156.444	164.59	164.70	.509375	2.0125	.000339	.001076	50	.05
30+00	.030	2	8	8.03	193.29	3.62	.20	156.524	164.55	164.75	1.00375	.1102	.000742	.001496	150	.22
33+00	.030	2	8	8.00	192.00	3.65	.21	156.764	164.76	164.97	1	.1112	.000754	.001551	50	.08
34+00	.030	2	8	7.90	188.02	3.72	.21	156.944	164.84	165.05	.9875	.1185	.000797	.001694	100	.17
36+00	.030	2	8	7.69	179.79	3.89	.23	157.309	164.99	165.22	.96125	.1341	.000902	.002019	200	.40
40+00	.030	2	8	7.32	165.72	4.22	.28	158.024	165.34	165.62	.915	.166	.001117	.002424	180	.49
43+60	.030	2	8	7.07	156.53	4.47	.31	158.672	165.74	166.05	.88375	.19425	.001307	.002916		.431
		USE	7.08	156.89	4.46	.31			165.75	166.06 USE	.885	.193	.001296	.002630	20	.105
44+00	.030	2	8	7.06	156.17	4.48	.31	158.744	165.80	166.11	.8825	.198	.001331			

Q=1200 | Q=1050 | Q=700 | S=.0018

GOOD FOR 120"ϕ UNDER US 101
WHICH IS NOT THE PROPOSED PROJECT

Q = 1200 b = 16 n = .030 $S = .00048 \left(\frac{1}{K}\right)^2$

Q = 1050 b = 16 n = .030 $S = .000373 \left(\frac{1}{K}\right)^2$

Q = 700 b = 16 n = .030 $S = .000166 \left(\frac{1}{K}\right)^2$

n = .014 $S = .000106 \left(\frac{1}{K}\right)^2$

b = 8 n = .030 $S = .000729 \left(\frac{1}{K}\right)^2$

b = 8 n = .014 $S = .001465 \left(\frac{1}{K}\right)^2$

b = 7 n = .014 $S = .002497 \left(\frac{1}{K}\right)^2$

REACH	Approx STA	Q	n	b	$b^{8/3}$	S	$K=\frac{Qn}{b^{8/3}S^{1/2}}$	$\frac{D}{b}$	D	$\frac{b}{y}$	k_1	$\tau=62.4k_1yS$	R	W	$\frac{R}{W}$	k_2	$\tau'=\frac{\tau}{k_2}$	Min PI
5	3,20	700	.030	14	1140	.0005	.8238	.549	7.69	1.8	.88	.21	400	44.76	8.9	.91	.23	7
5	20	700	.030	14	1140	.00215	.3973	.3825	5.36	2.6	.93	.67	400	35.49	11.3	.95	.71	10*
5	25,32,43	700	.030	8	256	.00215	1.77	.788	6.30	1.27	.83	.70	400	33.20	12.0	.96	.73	12*
5	50,65	700	.030	10	464	.0017	1.098	.6295	6.30	1.6	.87	.58	400	35.20	11.4	.95	.61	7
5	84	700	.030	10	464	.0017	1.098	.6295	6.30	1.6	.87	.58	1400	35.20	39.8	1.00	.58	7
5	91	700	.030	16	1630	.0008	.4555	.4098	6.56	2.4	.93	.30	400	42.24	9.5	.92	.33	7
4	95	520	.030	16	1630	.0008	.3384	.3523	5.64	3.0	.95	.27	400	38.56	10.4	.94	.29	7
4	106	520	.030	16	1630	.0008	.3384	.3523	5.64	3.0	.95	.27	1000	38.56	25.9	1.00	.27	7
3	110	450	.030	8	256	.0008	1.864	.807	6.46	1.2	.82	.26	400	33.84	11.8	.96	.27	7
3	110,119	450	.030	8	256	.0018	1.243	.668	5.34	1.5	.86	.52	400	29.36	13.6	.98	.53	7

Z = 2 throughout

* See HA-1 PI = 20+ for this CL & CH

** For τ .68 PI $\geq$ 7. Since the lowest PI for cohesive soil is 7, use Min. PI = 7 for $\tau \leq .68$

McCREARY · KORETSKY · ENGINEERS

BY AWW DATE 1-30-69 SUBJECT REACH 5 SHEET NO. 3.14 OF

CHKD. BY DATE BLOOMFIELD ALIGNMENT JOB NO. 1310

BASIN 7 & 8 SPRING

STA	n	z	b	D	A	V	hv	IE	HGL	EGL	$\frac{D}{d}$	$\left(\frac{1}{k}\right)^2$ or k'	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
0+00	.014	2	16	8.00	256.00	4.69	.34	144.140	152.74	153.08	.5	$\left(\frac{1}{k}\right)^2=2.17$	.000230	.002187	25	.05
0+50	.014	0	16	6.71	107.36	11.18	1.94	144.795	151.51	153.45	.4194	$\left(\frac{1}{k}\right)^2=18.46$	.001957			
								(1.94-.34).2=.32					153.08+.32+.05=153.45			
0+50	.013	2-7'ϕ		6.09	35.53	16.89	4.43	144.795	150.89	155.32	.87	k'=.485	.008072			
								(4.43+.94).175=.87					153.45+1.87=155.32	.016144	50	.81
1+50	.013	2-7'ϕ		6.09	35.53	16.89	4.43	145.605	151.70	156.13	.87	k'=.485	.008072			
1+50	.014	0	16	10.89	174.24	6.89	.74	145.605	156.50	157.24	.6806	$\left(\frac{1}{k}\right)^2=5.11386$	.000545			
								(4.43-.74).3=1.11					156.13+1.11=157.24	.000775	20	.02
1+70	.014	2	16	8.00	256.00	4.69	.34	148.959	156.96	157.30	.5	$\left(\frac{1}{k}\right)^2=2.17$	.000230			
								(.74-.34).1=.04					157.24+.04+.02=157.30			

$Q=1200 \quad n=.014 \quad b=16 \quad S=\left(\frac{1200\times.014}{1630}\right)^2\left(\frac{1}{k}\right)^2=.000106\left(\frac{1}{k}\right)^2$

$Q=600 \quad n=.013 \quad \phi=7 \quad S=\left(\frac{600\times.013}{179\times.485}\right)^2 \quad \text{For } \frac{D}{d}=.87$

THIS WAS USED FOR THE FINAL "2ND PROGESS REPORT" VS "BLOOMFIELD ALIGNMENT"
COMPARISON

McCREARY · KORETSKY · ENGINEERS

BY AW DATE 1-30-69 SUBJECT REACH 5 SHEET NO. 315 OF
CHKD. BY DATE BLOOMFIELD ALIGNMENT JOB NO. 1317

STA	T.B.	O.G.	CONTACT	I.E.	B	b	D	z	d	CLAY	CUT	FILL	LINING
0+00	158.2			141.737	15	16		2			0	0	
1+00	158.25	158.2	150.1	141.85	15	16	16.4	2	16.4	8.3	800	0	127
2+00	158.3	158.2	150.2	141.96					16.3	8.2	792	3	126
4+00	158.4	158.0	150.4	142.18	15	16	16.2	2	15.8	8.2	752	13	
6+00	158.5	157.5	150.6	142.40	15	16	16.1	2	15.1	8.2	698	34	
8+00	158.6	157.6	150.8	142.62	15	16	16.0	2	15.0	8.2	690	34	
10+00	158.7	157.0	151.0	142.84	15	16	15.9	2	14.2	8.2	630	63	126
12+00	158.8	156.0	151.2	143.06	15	16	15.7	2	13.9	8.1	609	67	125
14+00	158.9	156.6	151.4	143.28	15	16	15.6	2	13.3	8.1	567	90	
16+00	159.0	156.4	151.6	143.50	15	16	15.5	2	12.9	8.1	539	105	
18+00	159.1	157.0	151.8	143.72	15	16	15.4	2	13.3	8.1	567	81	
20+00	159.2	157.2	152.0	143.94	15	16	15.3	2	13.3	8.1	567	76	125
22+00	159.3	157.9	152.2	144.16	15	16	15.1	2	13.2	8.0	560	71	124
24+00	159.4	158.2	152.4	144.38	15	16	15.0	2	13.8	8.0	602	42	
26+00	159.5	158.4	152.6	144.60	15	16	14.9	2	13.8	8.0	602	38	
27+30	159.57	158.8	152.73	144.74	15	16	14.8	2	14.1	8.0	623	23	124/0
27+80	159.57	159.0	152.78	144.80	15	16	14.8	0	14.2		227/0	13/0	
28+20	160.0	160.0	152.88	145.61	15	16	14.4	0	14.4		0/230	0/0	
29+20	160.1	160.1	152.92	145.959	15	16	11.4	2	11.1	3.9	424	0	0/87
30+00	160.4	160.4	153.0	149.05					11.4	4.0	442	0	88
32+00	160.2	160.2	153.1	149.27					10.7	3.8	400	0	86
34+00	160.0	159.9	153.2	149.49	15	16	10.5	2	10.4	3.7	383	3	85
36+00	160.0	159.8	153.3	149.71	15	16	10.7	2	10.1	3.6	366	19	84
38+00	160.0	159.7	153.4	149.93	15	16	10.1	2	9.8	3.5	349	9	84
40+00	0.6	160.4	153.5	150.15	15	16	15	2	10.3	3.4	377	0	83
42+00	↓	160.4	154.4	150.37					11.0	4.0	418	0	88
44+00		162.4	155.4	150.59					11.8	4.8	467	0	95
46+10		163.6	156.4	150.81					12.6	5.6	519	0	102
47+40		165.4	158.4	150.96					14.4	7.4	695	0	119
47+90		166.0	159.0	150.98	15	16	15.0	0	15.0	8.0	690	0	+24

25269.50 CF 15,640 CF 43,450.5 CF

93,591 CY 5,579 CY 16,093 CY

+ 16,093 + 16093

109,684 CY 21,672 CY

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 1-30-69 SUBJECT REACHES 3,4,5 SHEET NO. 3.6 OF

CHKD. BY DATE R.O.W. AREAS JOB NO. 1317

124+20 150' x 80'

122+70

121+50 250 x 100

119+00 1120 x 95

107+80 40 x 135

107+40 60 x 135

106+80 1180 x 105

95+00 2[illegible] x 120

93+00 40x 115

92+60 60x 110

92+00 50x 115

91+50 135x120

90+45

80+15 115 x 70

85+00 500 x 140

80+00 1200 x 95

68+00 250 x 140

65+50 250 x 90

62+70 140 x 85

61+70 370x80

58+06 540 x95

52+60 400x 100

49+60 [illegible]

47+60 800 x 30

39+60 [illegible] x 120

33+70 170 x160

32+00 100 x175

31+00 300 x165

28+30 630 x175

21+70 200 x 1015

19+70 10 x 190

19+60 1010 x170

9+50 450 x 1675

5+00 100 x 170

4+00 400 x 160

0+00

143,600 = 3.29A ½ Orchard

194,500 = 4.49A Pasture

357,950 = 7.76A

361,650 = 8.30A Fields

649,915 = 14.91A Fields

STA	I.E.	b	D	z	H.G.L.	A	V	hv	E.G.L.	$\frac{D}{b}$	$\left(\frac{1}{K}\right)^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
10+20	162.06	8'	7.58	–	160.58	56.64	14.90	3.45	164.04	.8367	K'=.1773	.004459			
"	"	10	10.77	0	163.83	107.70	7.86	.96	164.79	1.077	1.032	.001065	.005524	20	.11
						(3.45-.96).3=.75			164.04+.75=164.79						
10+60	156.20	8	8.18	2	164.38	199.26	6.02	.56	164.94	① 1.0225	.1015	.000437			
						(.96-.56).3=.12			164.79+.12+.03=164.94						
"	"	"	"	"	"	"	"	"	"	③ "	"	.002007			
9+00	156.00	8	8.18	2	164.86	199.26	6.02	.56	165.42	② 1.0225	.1015	.002007	.004014	120	.48

S=.002292

Too High

8+60	152.353	T 10	7.95	0	160.30	79.50	10.65	1.76	162.06	.795	3.425	.002263			
"	"	10'ϕ	7.74	–	160.09	65.22	12.99	2.62	162.71	.774	[k'=.4374]	.002943	.005886	80	.47
						(2.62-1.76).75=.65			162.06+.65=162.71						
10+20	152.820	10'ϕ	7.74	–	160.56	65.22	12.99	2.62	163.18	.774	[k'=.4374] ④	.002943			
"		10	9.56	0	162.38	95.60	8.86	1.22	163.60	.956	2.19 ③	.001430	.001867	20	.04
						(2.62-1.22).3=.42			163.18+.42=163.60						
10+60	155.10	8	8.18	2	163.28	199.26	6.02	0.56	163.84	1.0225	.1015	① .000437			
						(1.22-.56).3=.20			163.60+.20+.04=163.84			② .002007			
9+00	155.54	8	8.18	2	163.76	199.26	6.02	0.56	164.32	1.0225	.1015	.002007	.004014	120	.48

S=.002292

REJECTED ALT. PROFILE

R=1200 ① n=.014 b=8 $S=.004307\left(\frac{1}{K}\right)^2$

R=1200 ② n=.030 b=8 $S=.019775\left(\frac{1}{K}\right)^2$

K=847 ③ n=.014 b=10 $S=.000653\left(\frac{1}{K}\right)^2$

K=847 ④ n=.013 d=10 $S=\left(\frac{847\times.013}{408\times.4374}\right)^2=.002943$

A.M.W. 1-6-69

REACH 5 BACKWATER ANALYSIS

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BY AJW DATE 1-13-69 SUBJECT Reaches 3 & 4 SHEET NO. 3 OF 12

CHKD. BY ____ DATE ____ Backwater Analysis JOB NO. 1317

STA	b	D	z	A	V	hv	I.E	H.G.L.	E.G.L.	D/b	$(\frac{1}{K})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
20+20	10	9.56	0	95.60	8.86	1.22	152.820	162.38	163.60	.956	2.19	.001430			
													.001770	20	.04
21+60	12	7.91	2	220.06	5.45	.46	155.500	163.41	163.87	.6592	① .6876	.000340			
						(1.22−.46)·3 = .23			163.60 + .28 + .04 = 163.87						
21+60	12	7.91	2	220.06	5.45	.46	155.500	163.41	163.87	.6592	② .6876	.001564			
													.003032	120	.36
22+80	12	8.03	2	225.32	5.33	.44	155.764	163.79	164.23	.6692	② .0454	.001468			
													.002116	100	.21
23+00	12	8.15	2	230.65	4.55	.32	155.924	163.91	164.23	.6792	③ .6061	.001055			
													.002128	150	.32
23+00	12	8.14	2	230.20	4.56	.32	155.934	164.12	164.44	.6783	.6096	.001061			
													.002145	200	.43
24+00	12	8.13	2	229.75	4.57	.32	156.314	164.49	164.76	.6775	.6128	.001067			
													.002162	200	.43
24+00	12	8.11	2	229.86	4.59	.33	156.754	164.86	165.19	.6758	.0194	.001078			
													.002173	200	.43
25+00	12	8.10	2	229.42	4.60	.33	157.194	165.29	165.62	.6750	.6225	.001084			
													.001654	50	.09
25+00	12	8.09	2	229.58	4.61	.33	157.634	165.72	166.05	.6742	.6256	.001089			
													.001355	200	.27
26+00	8	8.23	2	294.31	3.05	.19	157.919	165.95	166.14	1.02875 ④	.09284	.000665			
													.001408	200	.28
26+00	8	8.16	2	193.45	3.59	.19	158.059	166.22	166.41	1.02	.1026	.000690			
													.001656	230	.33
27+00	8	8.09	2	195.61	3.58	.20	158.379	166.49	166.69	1.01125	.10671	.000718			(use .34)
28+60	8	8.04	2	193.60	3.62	.20	158.790	166.83	167.03	1.005	.10565	.000738			
28+60	11	"	2	"	"	"	"	"	"	"	⑤ "	.000161			
29+00	8	7.36	0	58.88	10.19	1.61	158.824	166.18	167.79	.92	⑥ 2.40	.002585	.001746	20	.055
						(1.61−.20)·.5 = .705			167.03 + .705 + .055 = 167.79						.05
29+00	7Φ	6.81	—	33.22	15.70	3.83	158.82	165.63	169.46	.8729	⑦ k=.4926	.001828			
						(3.83−1.61)·.75 = 1.665			167.79 + 1.67 = 169.46				.015650	60	.94
25+20	7Φ	6.81	—	33.22	15.67	3.83	159.760	166.57	170.40	.8729	k=.4926	.001828			
25+20	8	10.81	0	86.48	6.94	.75	"	170.57	171.32	.1351	⑥ .9512	.001024			
						(3.83−.75)·.3 = .92			170.40 + .92 = 171.32				.001807	40	.07
26+00	36	3	2	126.00	6.56	.48	162.99*	170.99	171.47	.08755	$\left(\frac{700\times.014}{18.733\times18.7}\right)^2$ = .000783				
						(.75−.45)·3 = .08			171.32 + .08 + .07 = 171.47						

REJECTED ALT. PROFILE

* DS = 169.0

Q = 1200 b = 12 ① n=.014 $S = .001475\left(\frac{1}{K}\right)^2$

Q = 1050 b = 12 ③ n=.030 $S = .001741\left(\frac{1}{K}\right)^2$

Q = 1400 b = 8 ④ n=.030 $S = .006123\left(\frac{1}{K}\right)^2$

Q = 600 b = 8 ⑥ n=.014 $S = .001077\left(\frac{1}{K}\right)^2$

⑤ n=.014 $S = .001465\left(\frac{1}{K}\right)^2$

⑦ ϕ=7 n=.013 $S = .001899\left(\frac{1}{K}\right)^2$

③ n=.030 $S = .002274\left(\frac{1}{K}\right)^2$

McCREARY · KORETSKY · ENGINEERS

BY dw/wl DATE 1-15-69 SUBJECT Culvert 3 SHEET NO. 3/9 OF

CHKD. BY DATE Backwater Analysis JOB NO. 1317

6.5' dia CMP under Gastia Valley Road - Too Small

STA	b	D	z	A	V	h_v	I.E.	H.G.L.	E.G.L.	$\frac{D}{b}$	$\left(\frac{1}{K}\right)^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
124+00	8	7.36	0	58.88	10.19	1.61	158.824	166.18	167.79	.92	2.40	.002585			
							(1.61-.24) = 1.37		167.03+1.37+1.055 = 169.79						
124+00	6.5φ	6.49	=	33.17	18.09	5.08	158.824	165.31	170.39	.9985	$\left(\frac{1}{.4661}\right)^2$	.0129463	.0260935	60	1.57
						.130	(5.08+.161).75 = 2.60		167.79+2.60 = 170.39						
125+20	6.5φ	6.49	—	33.17	18.09	5.08	160.390	166.88	171.96		$\left(\frac{1}{.463}\right)^2$	.0131132			
125+20	8	12.35	0	98.80	6.07	0.57	"	172.29	173.31						
							(5.08-.57)/3 = 1.35		171.96+1.35 = 173.31						

Too High

REJECTED ALT. PROFILE

Q=600 6.5'φ n=.013 S=.002815 $\left(\frac{1}{K}\right)^2$

$b = 8$ $D = 8$ $Z = 2$ $n = .030$ $\frac{D}{b} = 1$ so $k' = 2.99$

$$S = \left(\frac{Qn}{b^{8/3}k'}\right)^2 = \left(\frac{.03Q}{256 \times 2.99}\right)^2 = \left(\frac{.03Q}{765.44}\right)^2 \text{ for } Q_{100/80}$$

$$k' = \frac{Qn}{b^{8/3}S^{1/2}} = \frac{.03Q}{256S^{1/2}} \qquad A = ZD^2 + 6D = 2D^2 + 8D = D(2D+8) = 2D(D+4)$$

REACH 4 $Q_{100/80} = 1050$

$S = \left(\frac{.03 \times 1050}{765.44}\right)^2 = .001694$, use $.00170$ $S^{1/2} = .04123$

$A = 192.0'$ $V = 5.47$

$Q_{100} = 750$

$k' = \frac{.03(750)}{256(.04123)} = \frac{22.5}{10.555} = 2.132$ $\frac{D}{b} = .8587$ $D = 6.87$ $6.87 + 1 = 7.87 < 8$

$A = 149.35$ $V = 5.02$ fps

$Q_{50} = 520$

$k' = \frac{.03(520)}{256(.04123)} = \frac{15.6}{10.555} = 1.478$ $\frac{D}{b} = .7245$ $D = 5.80$

$A = 113.68$ $V = 4.57$

$\frac{b}{y} \cdot \frac{b}{D} = \frac{1}{.7245} = 1.38$ $\tau = .86 w y S = .86 \times 62.4 \times 5.8 \times .0017 = 0.53$ PSF

IN PLASTIC SOIL THIS IS SAFE FOR PI ≥ 7

REACH 3 $Q_{100/80} = 700$ $S = \left(\frac{.28 \times 700}{765.44}\right)^2 = .000753$, try $.00076$ $S^{1/2} = .02757$

$Q_{100} = 550$ $k' = \frac{.03(550)}{256(.02757)} = 2.338$ $\frac{D}{b} = .8456$ $D = 7.16$ $D+1 = 8.16 > 8$

Using $D = 8-1 = 7$ $\frac{D}{b} = .875$ $k' = 2.220$

$S = \left(\frac{550 \times .03}{256 \times 2.22}\right)^2 = .000843$, use $.00085$ $S^{1/2} = .02915$

$Q_{50} = 450$ $k' = \frac{.03 \times 450}{256 \times .02915} = 1.809$ $\frac{D}{b} = .7958$ $D = 6.37$

$A = 132.11$ $V = 3.41$ fps

$\frac{b}{y} = \frac{b}{D} = \frac{1}{.7958} = 1.26$ $\tau = .84 w y S = .84 \times 62.4 \times 6.37 \times .00085 = 0.28$ PSF

IN PLASTIC SOIL THIS IS SAFE FOR PI ≥ 7

REACH 4 $Q_{100/50} = 1050$ cfs $b = 12$ $z = 2$ $n = .030$ $S = .0011$

$K' = \frac{Qn}{b^{8/3}S^{1/2}} = \frac{1050 \times .03}{755 \times .03317} = 1.258$ $D = 12 \times .672 = 8.07'$ $D_{min} = 8.1'$

$Q_{100} = 750$ $K' = \frac{750 \times .03}{755 \times .03317} = 0.898$ $D = 12 \times .573 = 6.88'$ $6.88 + 1 = 7.88 < 8.07$

$\therefore Q_{100/50}$ Rules for Freeboard

$Q_{50} = 520$ $K' = \frac{520 \times .03}{755 \times .03317} = 0.623$ $D = 12 \times .479 = 5.75'$

$\frac{b}{y} = \frac{1}{.479} = 2.09$ $\tau = .9 w y s = .9 \times 62.4 \times 5.75 \times .0011 = .36$ psf, Safe for PI ≥ 7

REACH 3 $b = 8$ $z = 2$ $n = .030$ $S = .00085$

$Q_{100/50} = 700$ $K' = \frac{700 \times .03}{256 \times .02915} = 2.81$ $D = 8 \times .973 = 7.78$

$A = 18.3 a'$ $V = 3.83$ $h_v = .23$ $D_{min} = 8.0'$

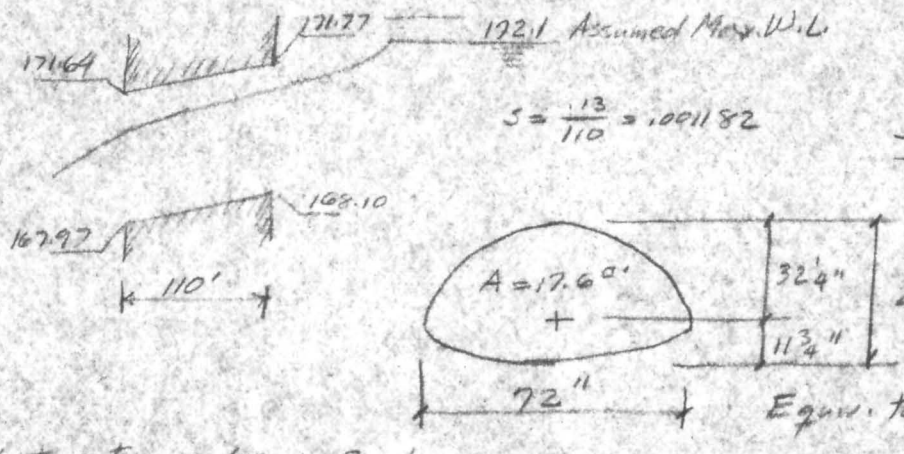
$Q_{100} = 550$ $K' = \frac{550 \times .03}{256 \times .02915} = 2.21$ $D = 8 \times .873 = 6.98$ $6.98 + 1 = 7.98'$

Q_{100} Rules for Freeboard

$Q_{50} = 450$ $K' = \frac{450 \times .03}{256 \times .02915} = 1.81$ $D = 8 \times .796 = 6.37$

$\frac{b}{y} = \frac{1}{.796} = 1.26$ $\tau = .83 w y s = .83 \times 62.4 \times 6.37 \times .00085 = .28$ psf, Safe for PI ≥ 7

72"×44" CMPA Under Castro Valley Road (Existing)



$S = \frac{.13}{110} = .001182$

172.1
+ .23
172.33 Assumed EGL o/s
− 168.10
4.23 = D + h_v + .3 Δh_v

Let entrance loss = .3 Δh_v

Try for EGL o/s of 172.33

72" x 44" CMPA Under Castro Valley Road, Cont.

REF: BPR, "Design Charts for Open Channel Flow"

Try Q = 80 cfs @ outlet $D_c = 1.88$ $\frac{d}{D} = .513$ $\frac{Q}{Q_{FULL}} = .62$ $\frac{V}{V_{FULL}} = 1.68$ $\frac{S}{S_{FULL}} = 2.6$

$Q_{FULL} = \frac{80}{.62} = 129$ $V_{FULL} = \frac{80}{17.6} = 4.55$ $V = 4.55 \times 1.68 = 7.65$ $h_v = .91$

$S_{FULL} = .0046$ $S = .0046 \times 2.6 = .012$

167.97 IE
1.85
169.85 HGL
.91
170.76 EGL

AT INLET, Q = 80 IE = 168.10

d	$\frac{d}{D}$	$\frac{Q}{Q_F}$	$\frac{V}{V_F}$	$\frac{S}{S_F}$	Q_F	V_F	S_F	S	V	h_v	HGL	EGL	$\left(\frac{S_1+S_2}{2}\right)10 = H$	170.36 + H
3.5	.953	1.05	1.015	.87	76	4.55	.0046	.004	4.62	.33	171.60	171.93	.88	171.64
3.2	.873	1.07	1.05	.875	75	"	"	.004	4.72	.35	171.30	171.65	.86	171.64
3.19	.869		1.06	.88	"	"	"	.004	4.82	.36	171.29	171.65	.88	171.64
3.48	.867		1.06	.882	"	"	"	.004	4.82	.36	171.28	171.64	.88	171.64

.3(1.32 − 1.24) = .3 × .13 = .04 171.64 + .04 = 171.68 < 172.33

Sta	Q	d	$\frac{d}{D}$	$\frac{V}{V_F}$	$\frac{S}{S_F}$	V_F	S_F	V	S	h_v	IE	HGL	EGL	S_1+S_2	ΔH
0+00	100	2.15	.587	1.17	1.8	5.68	.0072	8.35	.013	1.04	167.97	170.13	171.20		
														.0192	1.06
1+10	100	3.4	.924	1.03	.86	"	"	5.85	.0062	.53	168.10	171.50	172.03		
		3.6	.981	1.01	.915	"	"	5.74	.0066	.51	"	171.20	172.22	.0196	1.08
		3.67				"	"	5.68	.0072	.50		171.27	172.27	.0202	1.11

.3(.50 − .23) = .3(.27) = .08 171.20 + 1.11 + .08 = 172.39 ≈ 172.33

$Q = 100 \text{ cfs} \pm 10 \text{ cfs}$

Size New Culvert for $Q_{100/50} = 700 - 100 = 600$ cfs

CHECK 50 YR. FLOW TRACTIVE FORCES

$K' = \frac{Qn}{b^{.313} S^{1/2}} = \frac{Q}{8533\, S^{1/2}}$ $n = .030$ $b = 8$ $z = 2.0$

REACH	Q	S	K'	$D_{16}=D_{16}$	$\frac{b}{d}$	C	τ	$D=y$	A	V	$\frac{V^2}{2g}$
1	155	.00238	.372	.370	2.7	.94	0.41	2.96	41.2	3.76	0.22
2	510	.00137	1.615	.756	1.3	.85	0.49	6.05	121.6	4.19	0.27
3	450	.00159	1.323	.688	1.45	.86	0.47	5.50	104.5	4.31	0.29
4	520	.00135	1.659	.766	1.3	.85	0.44	6.13	124.2	4.19	0.27
5	700	.00127	2.302	.889	1.1	.82	0.46	7.11	158.0	4.43	0.30

$\tau = C w y S$ C = constant from Fig 7-7, Page 169, Chow

$w = 62.4$ PCF y = depth of water, S = gradient

$Q_{50} = 700$

$Q_{100} = 850$

$Q_{100/80} = 1,200$

Try unlined channel bank full for $Q_{100/80}$, $b=8$ $D=8$ $z=2$ $n=.030$

$$S=\left(\frac{Qn}{b^{8/3}k'}\right)^2=\left(\frac{1200\times.03}{256\times2.99}\right)^2=\left(\frac{36}{765.44}\right)^2=.047032^2=.002212,\ \text{say } .0022$$

Check Q_{100} for $S=.0022$

$$k'=\frac{Qn}{b^{8/3}S^{1/2}}=\frac{850\times.03}{256\times.0469}=\frac{25.5}{12.01}=2.123 \qquad D/b=.857 \qquad D=6.86'$$

$$\text{Freeboard}=8-6.86=1.14'>1'$$

Find Tractive Force for Q_{50}

$$k'=\frac{700\times.03}{12.01}=\frac{21}{12.01}=1.749 \qquad D/b=.784 \qquad D=6.27'$$

$$b/y=\frac{1}{.784}=1.3 \qquad \tau=.84\ wyS=.84\times62.4\times6.27\times.0022=.72\ psf$$

A Tractive Force of .73psf is marginal for PI=12
and barely safe for PI>12
A Tractive Force of .71psf is marginal for PI=10

Find V, h_v for $S=.0022$

	Q	D	A	V	$\frac{V^2}{2g}$
$Q_{100/80}$	1200	8	192	6.25	0.61
Q_{100}	850	6.86	149.0	5.70	0.50
Q_{50}	750	6.27	128.8	5.82	0.53

The Second Progress Report Alignment appears to pass through material with a PI $\geq$ 12 so a minimum section with $S=.0022$ is acceptable for it. The drop required for $S=.0012$ may be deleted.

FIND MAX. ALLOW. SLOPE FOR $b=8$, $Z=2$, $n=.030$ FOR PI = 20

$Q_{50} = 700$

Try $S = .0025$ and $.0026$

$K' = \frac{700 \times .03}{256 \times .105} = \frac{21}{12.8} = 1.6006$

$D = 8 \times .7621 = 6.097$ $\frac{Y}{b} = 1.31$

$T = .85 \times 62.4 \times 6.099 \times .0025 = 0.81$ PSF

PI = 19 Min.

$K' = \frac{700 \times .03}{256 \times .105099} = \frac{21}{13.05} = 1.6092$

$D = 8 \times .7549 = 6.038$ $\frac{Y}{b} = 1.32$

$T = .85 \times 62.4 \times 6.038 \times .0026 = 0.83$ PSF

PI = 20 Min.

FIND MAX. ALLOW. SLOPE FOR $b=8$, $Z=2$, $n=.030$ FOR PI = 10

$Q_{50} = 700$

Try $S = .0021$ and $.00215$

$K' = \frac{700 \times .03}{256 \times .045826} = 1.7401$

$D = 8 \times .7920 = 6.34$ $\frac{Y}{b} = 1.26$

$T = .84 \times 62.4 \times 6.34 \times .0021 = 0.70$ PSF

PI = 9 Min.

$K' = \frac{700 \times .03}{256 \times .046368} = 1.7691$

$D = 8 \times .7873 = 6.30$ $\frac{Y}{b} = 1.27$

$T = .84 \times 62.4 \times 6.30 \times .00215 = 0.71$

PI = 10 Min.

FIND MAX. ALLOW. SLOPE FOR $b=8$, $Z=2$, $n=.030$ FOR PI = 7

$Q_{50} = 700$

Try $S = .0020$

$K' = \frac{700 \times .03}{256 \times .044921} = 1.8343$

$D = 8 \times .8009 = 6.41$ $\frac{Y}{b} = 1.25$

$T = .84 \times 62.4 \times 6.41 \times .002 = 0.67$ PSF

PI = 7 Min.

PI	S_{MAX}
7-10	.00200
10-20	.00215
20+	.00260

The Bloomfield Road alignment boundary runs into some other soils.

SC $D_{75} = 0.25$mm
SM $D_{75} = 0.5$mm
SM $D_{75} = 0.25$mm

These indicate use of Curve 1 which means $V = 1.2$ fps for $D_{75} = 0.5$mm and $V = 1.0$ fps for $D_{75} = 0.25$mm. These are base velocities.

For intermittent flow in non-cohesive soil $V_{allow} = V_{base} \times D \times A \times B$

$V_{allow} = 1.0 \times 1.203 \times 1 \times 0.87 = 1.047$ fps for 8' deep and 3:1 slopes
$z = 3$ due to soil

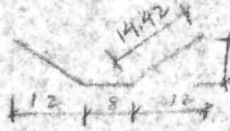
$A = \frac{Q}{V} = \frac{1200}{1.05} = 1143'$ $\quad A = bd + zd^2 = 8b + 3(8)^2 = 8b + 192$

$8b + 192 = 1143$ $\quad b = 119'$; use $120'$

R.O.W. $= 15 + 3\times8 + 120 + 3\times8 + 15 + x = 198 + x$, say 200'
$3,000 per Acre = $0.06887 per Sq. Ft.
Exc. $= 1143' = 42.3$ CY/LF

$200 \times \$0.06887 = \$13.77$
$42.3 \times 1.20 = 50.76$
UNLINED CANAL $64.53 PER LF

A lined canal would have the minimum dimensions of $b = d = 8'$, $z = 1.5$



$14.42 + 8 + 14.42 = 36.84'$ $\quad 36.84 \times \frac{1}{3} \times \frac{1}{27} = 0.4548$ CY/LF
4" thick lining

Exc. $= 8\times8 + 1.5\times8\times8 = 160' = 5.93$ CY/LF
R.O.W. $= 15 + 12 + 8 + 12 + 15 + x = 62 + x$, say 70'

$70 \times \$0.06887 = \$4.82$
$5.93 \times 1.20 = 7.12$
$0.4548 \times 60.00 = 27.29$
$39.23

FOR PCC AT $450.00 PER CY, THIS IS $30.89 PER LF
Less $20,000 per mile maintenance credit 3.79
P.C.C. LINED CANAL $35.44 PER LF

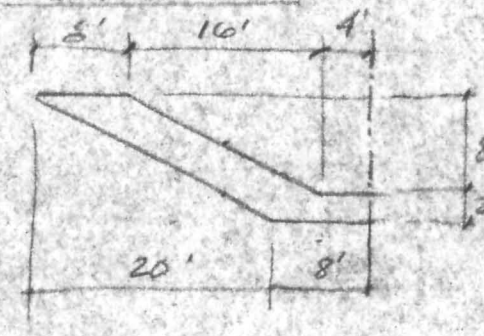
A vertical sided lined channel would have $b = d = 8'$
R.O.W. $= 15 + 8 + 15 + x = 38 + x$, say 40'
Exc. $= 8\times8 = 64$ CF $= 2.37$ CY/LF
Pcc $= (8+8+8)\frac{2}{3} \times \frac{1}{27} = .5926$ CY/LF
8" thick

$40 \times \$0.06887 = \$2.75$
$2.37 \times 1.20 = 2.84$
$0.5926 \times 90.00 = 53.33$
$58.92
Less maint. credit 3.29

McCREARY · KORETSKY · ENGINEERS

BY A.W. DATE 12-23-68 SUBJECT REACH 5 SHEET NO. 327 OF
CHKD. BY DATE Most Econ. Sect. JOB NO. 1317
For Full Depth Lining

CLAY LINING



Excavation
$10 \times 16 + 2(10^2) = 360^{\square'}$
$360 \div 27 = 13.33$ CY/LF

Waterway
$8 \times 8 + 2(8)^2 = 192^{\square'}$

Clay Lining $= 360 + 192 = 168^{\square'}$
$168 \div 27 = 6.22$ CY/LF

R.O.W. $15 + 16 + 8 + 16 + 15 = 70'$, use $80'$
$80 \div 43560 = .001837$ A/LF

Excavation	13.33 CY	@ $1.20 =	$16.00
Embankment	6.22 CY	0.80	4.98
R.O.W.	0.001837 A	3,000.00	5.51
			$26.49

Bloomfield Road Alignment, modifications due to soils, cont.:

Try soil cement lined channel with minimum dimensions

$b = d = 8'$ $\quad z = 4$ $\quad \frac{D}{b} = 1$ $\quad s = \left(\frac{Qn}{k' b^{8/3}}\right)^2 = \left(\frac{1200 \times .03}{4.43 \times 256}\right)^2 = .000813$

$A = bd + z d^2 = 64 + 4 \times 64 = 320 \square'$

$V = \frac{Q}{A} = \frac{1200}{320} = 3.75 fps$

R.O.W. $= 15 + 32 + 8 + 32 + 15 + x = 102 + x$, use 110'

Exc. $= 320 \times \frac{1}{27} = 11.85$ CY/LF



$32.98 + 8 + 32.98 = 73.96$

$73.96 \div 9 = 8.22$ S.Y./LF.

$110 \times \$ 0.106667 =$	$\$ 11.58$	
$11.85 \times 1.20 =$	14.22	$\$ 34.13$
$8.22 \times 1.50 =$	12.33	$- 3.79$
	$\$ 34.13$	$\$ 30.34$

Less $\$ 10.00$ per mile maint. credit 1.89

SOIL CEMENT LINED CANAL $\$ 32.29$ PER LF.

Comparison of Alternative Costs per L.F.

Unlined trapezoidal	$\$ 64.53$	
Vert. Sided Concrete Lined	55.13	
Concrete Lined Trapezoidal	35.44	4" PCC @ $\$ 60$ per CY
Soil Cement Lined Trapezoidal	32.24	$\$ 15.00$ per SY; $\frac{1}{2}$ Maint. Credit
Concrete Lined Trapezoidal	30.89	4" PCC @ $\$ 50$ per CY
Soil Cement Lined Trapezoidal	30.34	$\$ 15.00$ per SY; Full Maint. Credit
Clay Lined Trapezoidal	26.49	

The above include R.O.W. and credits (where due) for reduced maintenance

Quantity of Lining:

$(27+60) - (19+40) = 2620$

$(47+70) - (29+90) = 1860$

$4480'$

$4480 \times 8.22 = 36826$ S.Y.

Extra R.O.W.: $8 \times 8' - 4 \times 9.2' = 27.2'$, say $30'$

$\frac{30 \times 4480}{43,560} = 3.085$ A

$10.783 + 3.085 = 13.868$ A

ASSUME S GREAT ENOUGH FOR b = 8' MIN & D = 8' MIN.

P.C.C. INVERT



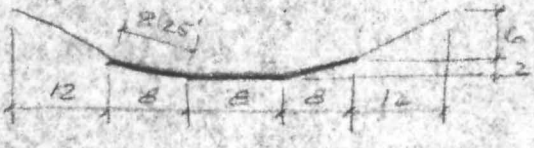
z = 1.5 bottom 2' (vert.)
z = 2 above
The stability of this section must be checked before it is used for anything beyond the scope of this sheet.

P.C.C.:	$(3.61+8+3.61)\frac{1}{2} \times 1' \times \frac{1}{27}$ = .1879 CY	@	$60.00	= $11.27
Canal Exc.:	$\frac{(6\times(12+19))+2\times(3+9)}{27}$ = 6.3926 CY	@	1.20	= 7.91
R.O.W.:	80 × 43560 = 0.021837 A	@	3,000.00	= 5.51
				$24.69

15+12+3+8+3+12+15 = 68', use 80' ROW

SOIL CEMENT INVERT

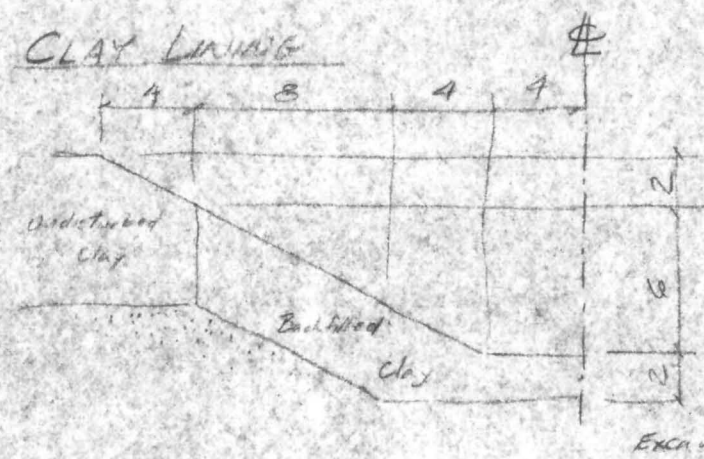
z = 4 bottom 2' (vert.)
z = 2 above



Soil Cem.:	$\frac{(8.25+8+8.25)}{27}$ = 2.7222 S.Y.	@	$1.50	= $4.08
Canal Exc.:	$\frac{6\times12^{9}+6\times24+2\times8+4\times8^{5}}{27}$ = 9.1852 CY	@	1.20	= 11.02
	.002066 A	@	3,000.00	= 6.20
				$21.30

15+12+8+8+8+12+15 = 78', Say 90' R.O.W.
90 × 43560 = .002066

CLAY LINING



Gross Exc.: $\left(\frac{40+32}{2}\right)2 + 32\times4 + \left(\frac{32+16}{2}\right)4$
= 72 + 128 + 96 = 296 SF → 10.96 CY/LF
Waterway = 8×8 + 2×8² = 192 SF
Backfill = $2\left(4\times8\right) + \left(\frac{4\times4}{2}\right)4 + 2\times8$
= 104 SF → 3.85 CY/LF
Use 80' R.O.W.

Excavation	10.96 CY	@	$1.20	= $13.15
Embankment	3.85 CY		0.80	3.08
R.O.W.	0.021837 CY		3,000.00	5.51
				21.74

SOIL CEMENT LINING



Exc.: $(2C^2+8C(N+1)+4N^2+8N)\frac{1}{27}$

$=(2C^2+8CN+8C+4N^2+8N)\frac{1}{27}$

Soil Cem.: $(2\sqrt{17}N+8)\frac{1}{9}=(8.24N+8)\frac{1}{9}$

R.O.W.: $(6+15+2C+4N+8+4N+2C+15+6)\frac{1}{43,560}$

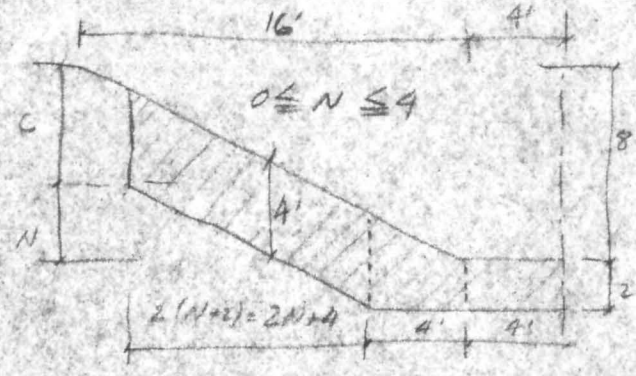
$=\left(\frac{50+4C+8N}{43,560}\right)$

For N=8, the cost is $32.24/LF

N	2		3		4		5		6	
C	6		5		4		3		2	
Exc. @ $1.20/cy	9.185	$11.02	10.000	$12.00	10.667	$12.80	11.185	$13.42	11.556	$13.87
Soil Cem. @ $1.50/sy	2720 (90')	4.08	3.636 (94')	5.45	4.551 (98')	6.83	5.467 (102')	8.20	6.382 (106')	9.57
R.O.W. @ $3000/A	.002067	6.20	.002158	6.47	.00250	6.75	.002342	7.03	.002433	7.30
		$21.30		$23.92		$26.38		$28.65		$30.74

These figures allow no maintenance credit

CLAY LINING



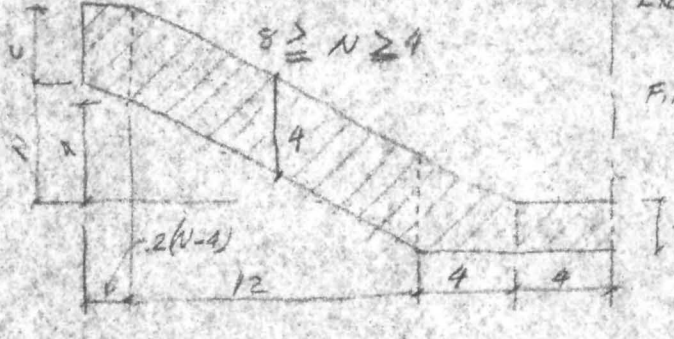
Exc.: $2(8^2)+8\times8+2\left[4(2N+4)+4\left(\frac{4+4}{2}\right)\right]+2\times8$

$=(264+16N)\frac{1}{27}$

Fill: $2\left[4(2N+4)+4\left(\frac{4+4}{2}\right)\right]+2\times8$

$=(72+16N)\frac{1}{27}$

R.O.W.: $(6+15+16+4)\frac{2}{43,560}=\frac{82}{43,560}=.001882A$



Exc.: $\left[\frac{8+N}{2}(40+2(2N-8))+2(N+2)^2+16(N+2)\right]\frac{1}{27}=$

$\left[-2N^2+32N+232\right]\frac{1}{27}$

Fill: $\left[2(2(N-4)\left(\frac{8-N}{2}\right)+12(4)+4\left(\frac{4+4}{2}\right)+4(2)\right]\frac{1}{27}=$

$\left[-2N^2+32N+40\right]\frac{1}{27}$

For N=8, the cost is $26.49/LF

N	2		3		4		5		6	
C	6		5		4		3		2	
Excavation @ $1.20/cy	10.963	$13.16	11.556	$13.87	12.148	$14.58	12.669	$15.20	12.037	$15.64
Embankment @ $1.50/cy	3552 (82')	3.08	4.449 (92')	3.56	5.037 (82') Same	4.03	5.526 (82') Same	4.44	5.926 (82') Same	4.74
R.O.W. @ $3000/A	.00182	5.65 (82')	Same	5.65 (82')	Same	5.65 (82')	Same	5.65 (82')	Same	5.65
		$21.89		$23.08		$24.26		$25.29		$26.03

b=8' min. and d=8' min.

Compare these for Q=1200, n=.030, z=2, IE=132.5, OG=137, S=.0005, Top of berm el. 142.5, and berm top width =15

$K = \frac{Qn}{b^{8/3}S^{1/2}} = \frac{1200\times.03}{256\times.02236} = \frac{36}{5.724} = 6.289$ $\frac{D}{b} = 1.387$ D=11.10

$K = \frac{Qn}{D^{8/3}S^{1/2}} = \frac{1200\times.03}{256\times.02236} = \frac{36}{5.724} = 6.289$ $\frac{D}{b} = .291$ b=27.5

ROW = 2F+15+2F+2C+b+2C+2F+15+2F = 30+b+8F+4C

Min. R.O.W. = 15+2D+b+2D+15 = 30+b+4D

b=8 D=11.10 IE+D = 143.6 > 142.5 ∴ F = 143.6−OG = 6.6 C = OG−IE = 4.5

R.O.W. = 38+8×6.6+4×4.5 = 108.8'

Min. R.O.W. = 38+4×11.1 = 82.4'

b=27.5 D=8 IE+D = 140.5 < 142.5 ∴ F = 142.5−OG = 5.5 C = 4.5

ROW = 57.5+8×5.5+4×5.5 = 119.50

Min. R.O.W. = 57.5+4×8 = 89.5'

check exc. and emb. areas:

cut = bC+2C²

fill = 30F+4F²

b=8 D=11.1 F=6.6 C=4.5 cut=765.0' fill=392.2' cut+fill = 448.7 □'

b=27.5 D=8 F=5.5 C=4.5 cut=1643.0' fill=286.0' cut+fill = 450.3 □'

the cut+fill values are virtually equal (Δ=0.3%)

the b=27.5 x D=8 channel has more nearly balanced earthwork but a wider R.O.W.

Interestingly, this section is really 10' deep, hydraulically speaking, and, therefore, we may reduce either S or b

D=10 S=.0005 n=.030 Q=1200 F=5.5 C=4.5 z=2

$K = \frac{Qn}{D^{8/3}S^{1/2}} = \frac{1200\times.03}{464\times.02236} = \frac{36}{10.375} = 3.470$ $\frac{D}{b} = .730$ b=13.70'

R.O.W. = 30+13.7+8×5.5+4×4.5 = 105.7'

Min. R.O.W. = 30+13.7+4×10 = 83.7'

cut = 102.2 □' fill = 286.0 □' cut+fill = 388.2 □'

except for 1.3' of min. R.O.W., this is an improvement all around

A = 10×13.7+2×10² = 337 □' V = 1200/337 = 3.56 fps

In effect, we have D=10' min. "free" so let us look at S=.0002

$K = \frac{Qn}{D^{8/3}S^{1/2}} = \frac{1200 \times .03}{464 \times .01414} = \frac{36}{6.561} = 5.487$ $\frac{D}{b} = .135$ $b = 22.86'$

For F=5.5, C=4.5 R.O.W. = 30+22.9+8×5.5+4×4.5 = 114.9'

Min. R.O.W. = 30+22.9+4×12 = 92.9'

Cut = 143.60' Fill = 286.0' Cut + Fill = 429.6'

$A = 10 \times 23.9 + 2 \times 10^2 = 439'$ $v = \frac{1200}{439} = 2.73$ fps

In 3000 LF (30 Sta.) this saves us 3000 (.0005 − .0002) = 0.9' of grade

However, we have up to 42' more cut per LF and 9' more R.O.W.

THEREFORE, FROM STA 0+00 TO ABOUT STA 30+00 OF REACH 5, USE:

b = 14 D = 10* z = 2 S = .0005

Check S for Q = 1200 and n = .030 $\frac{D}{b} = \frac{10}{14} = .7143$.

$S = \left(\frac{Qn}{K' b^{8/3}}\right)^2 = \left(\frac{1200 \times .03}{1.431 \times 1140}\right)^2 = \left(\frac{36}{1631}\right)^2 = .000487$

or, for b=14 z=2 S=.0005 n=.030 find D

$K' = \frac{Qn}{b^{8/3}S^{1/2}} = \frac{1200 \times .03}{1140 \times .02236} = \frac{36}{25.49} = 1.412$ $\frac{D}{b} = .648$ $D = 9.35$*

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BY AJW DATE 12-23-68 SUBJECT REACH 5 SHEET NO. 333 OF
CHKD. BY DATE FARM CROSSINGS JOB NO. 1217

BRIDGE
WIDTH = 16'
LENGTH = 40 + 6 = 42+14 = 56'





Assuming 12" ave thickness, A = 1 (56+21) = 77 □' Deck & Piers
Add 1'x3' Footings, A = 77 + 4x3 = 89 □'

$\frac{89 \times 16}{27} = 53$ CY

Line For 60 LF

53
+14
67 CY Str. Plc, @ $90.00 = $6,030

Cutoff = $2(23.48 \times 2 + 14) 3' \times 1' \times \frac{1}{27} = 13.5$ CY

Lining Plc $\frac{60' \times (23.48 \times 2 + 14) \times \frac{1}{3}'}{27} = 45$ CY Lining Plc @ $60.00 = 2700

Str Exc Footings $4(1' \times 5' \times 18') \frac{1}{27} = 13.3$
Cutoff $3 \times 13.5 = \frac{40.5}{53.8}$ 54 CY Str. Exc. @ $4.00 = 216

Backfill Footings $4(90 - 1' \times 3' \times 16') \frac{1}{27} = 6.2$
" Cutoff $2 \times 13.5 = \frac{27.0}{33.2}$ 33 CY Backfill @ $6.00 = 198

Guardrail $2 \times (20 + 56 + 20) = 192$, Say, 200 LF Guardrail @ $2.00 = 400

$9544

Subtotal

Canal Exc. $19 \times 10.5 + 2 \times 10.5^2 = 367.5$ □'

$\frac{110 \times 367.5}{27} = 1497$ 1497 CY Canal Exc @ $1.20 = 1796

$11340

Total for gross Length of 110 LF = $11,340

Bridge costs less to build and maintain

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BY AJW DATE 12-23-68 SUBJECT REACH 5 SHEET NO. 334 OF
CHKD. BY DATE FARM CROSSINGS JOB NO. 7317

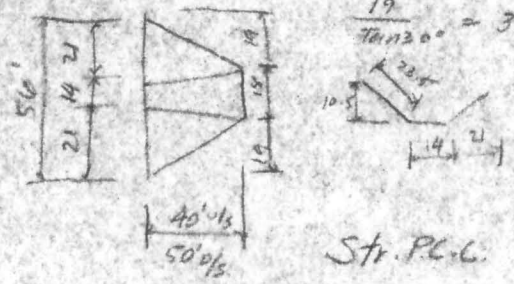
CULVERT

Try 2-96"ϕ R.C.P. flowing full x 20' Long

$A = 100.54^{sf}$ $V = \frac{1200}{100.54} = 11.94$ fps $h_{v_2} = 2.21'$

Canal $V_1 = 2.32$ fps $h_{v_1} = 0.17'$ $\Delta h_v = 2.04$ $1.15 \Delta h_v = 2.35$

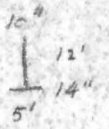
$H_f = 4.66\, l \left(\frac{Q_n}{d^{8/3}}\right)^2 = 4.66 \times 20 \left(\frac{1200 \times .013}{256}\right)^2 = .235'$ $H_f = .135$, $H = 2.70$



$\frac{19}{\tan 20°} = 33'$ $\frac{18}{\tan 22.5°} = 46'$

$2 \times 23.5 + 19 = 61'$ $2 \times 10.5 + 18 = 39'$

Str. P.C.C. Headwall



$(12' \times 22' - 100.5^{sf}) .83' = 136$ cf

$5' \times 22' \times 1.17' = 128$

$264 \times 2 = 528$ cf $= 396$

Cut offs $2(23.5 \times 2 + 14) 3' \times 1'$

894 ÷ 33 cy Str. P.C.C. @ $90 = $2970

Lining P.C.C. $\left(\frac{61+39}{2}\right)(40+50) \frac{1}{3} \times \frac{1}{27} = 55.56$

56 cy Lin. P.C.C. @ $60 = 3360

Str. Exc. $\left[2(7' \times 24' \times 2.17') + \frac{3'}{1'}(396\text{ cf})\right] \frac{1}{27} = 68$

68 cy Str. Exc. @ $4 = 272

Backfill $\left[2(7 \times 24 - 5 \times 22)2.17) + \frac{2'}{1'}(396\text{ cf})\right] \frac{1}{27} = 36$

36 cy Backfill @ $6 = 216

96"ϕ RCP

40 LF RCP @ 115.00 = 4608

Canal Exc. $\left(\frac{368 + 44 \times 18}{2}\right) 50 \times 40 \frac{1}{27} = 943$

943 cy Canal Exc. @ $1.20 = 1132

Gross Length = 40 + 20 + 50 = 110 LF

200 LF Guardrail @ $2 = 400

$12,558

Total for gross length of 110 LF = $12,558

Build bridge unless drop needed

	A	n	b	Z	D	A	V	hv	IE	HGL	EGL	D/b	K' or $(\frac{1}{K_1})^2$	S	S_1+S_2	$\frac{\Delta L}{2}$	ΔH
12+10		.014	8	2	7.08	156.89	4.46	.31	158.318 (=.01242)	165.40	165.71	.885	$(\frac{1}{K_1})^2=.193$	.000283			
12+50		.014	8	0	6.19	49.52	14.14	3.10	158.390	164.58	167.68	.77375	$(\frac{1}{K_1})^2=3.705$	.005428	.005711	20	.11
								.5(3.10 − .31) = 1.40			165.71+1.40+.11 = 167.22 < 167.68				DISSIPATOR NEEDED		
21+50		.013	7.5	ϕ	5.16	32.41	21.60	7.24	158.390	163.55	170.79	.688	K'= .3786	.012387			
								n<(7.29−3.10) = 3.11			167.68+3.11 = 170.79				.024774	60	1.49
22+70		.013	7.5	ϕ	5.16	32.41	21.60	7.24	159.880	165.09	172.28	.688	K = .3786	.012387			
22+70		.014	8	0	13.75	110.00	6.26	.63	159.880	173.63	174.26						
								.30(7.29−.63) = 1.98			172.28+1.98 = 174.26						
23+50		.04	36	2													
23+50		.030	36	2													

$Q = 700$ $b = 8$ $n = .014$ $S = .001465(\frac{1}{K_1})^2$ $n = .030$ $S = .006739(\frac{1}{K_1})^2$

WL 173.63 IS too high so a large pipe is needed, say 8'ϕ

Extra Cost: 120 LF 8'ϕ vs 7'ϕ, Jacked 120LF@($280-240) = $4,800

Save Str. PLC: Say 30 CY @ $100 = 3,000

4' × 4' (4+6+4).67 × 60 LF = 500 CF = 21 CY
6' Bridge: 6' × 15' × .83' = 75 CF = 3 CY
24 CY

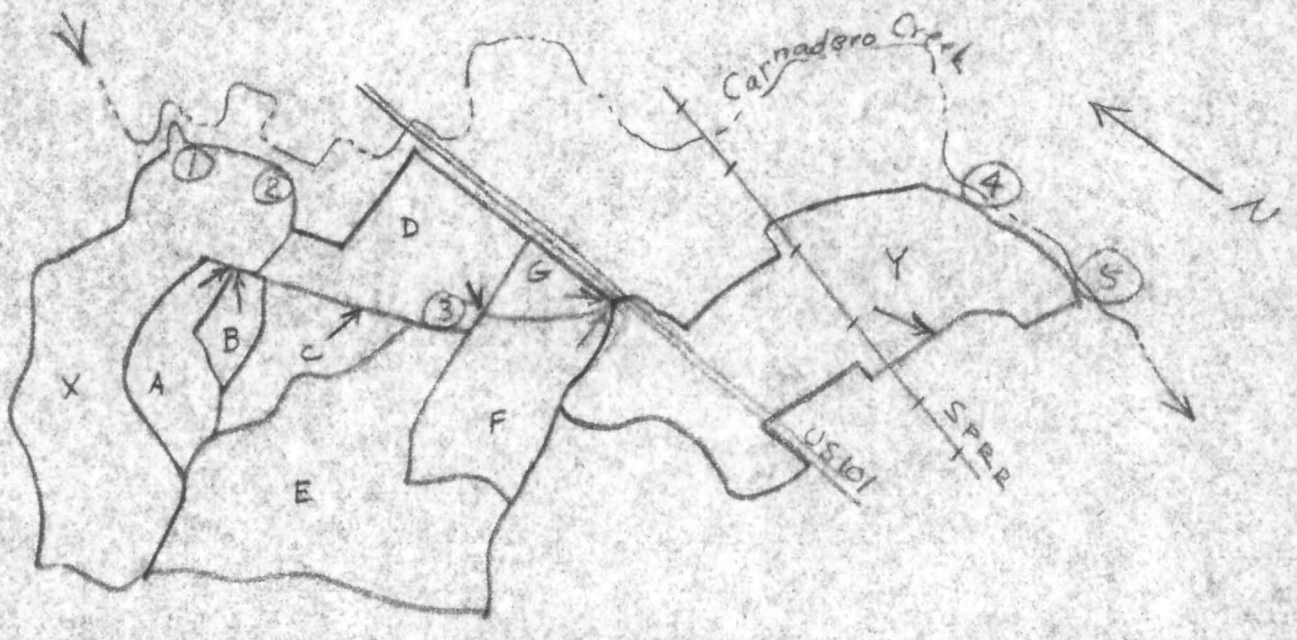
USE NEW 7'ϕ + OLD CMPA

TRY PUTTING ALL OF 700 CFS UNDER CASTRO VALLEY RD.

Section 4

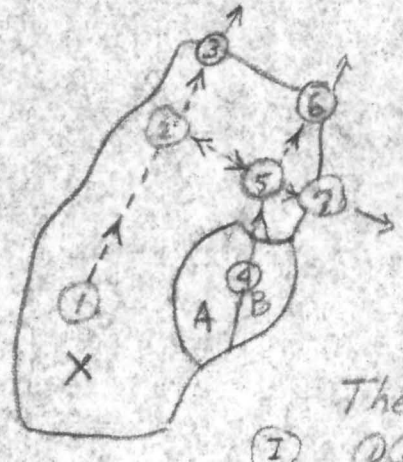
North Unit

Preliminary Route Comparisons



Watersheds C, D, E, F, G, and Y must enter Carnadero Creek at either (4) or (5)

However, Watersheds X, A, and B may enter at (1), (2), (4), or (5); To exit at (4) or (5) they must pass through (2)



Watersheds A and B are the sources of Reach 1; Watersheds A, B, and X are the sources of Reach 2. ∴ Watershed X yields (Reach 2 – Reach 1).

The likely configurations are;

I	(1)(2)(3)	plus	(4)(5)(6)
II	(1)(2)(3)	plus	(4)(5)(7)
III	(1)(2)(3)	plus	(4)(5)(2)(3)
IV	(1)(2)(5)(3)	plus	(4)(5)(6)
V	(1)(2)(3)(7)	plus	(4)(5)(7)

The balance are unlikely

VI	(1)(2)(5)(6) plus (3)(5)(7)	Reach (3)(6) can include A&B at negligible added cost
VII	(1)(2)(5)(4) plus (4)(6)(2)(5)	Same plus much more channel length
VIII	(1)(2)(5)(2) plus (3)(5)(6)	Same as 2nd above
IX	(1)(2)(5)(2) plus (4)(5)(7)(3)	Same as 2nd above

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BY AJW DATE 12-10-68 SUBJECT REACHES 1 & 2 SHEET NO. 403 OF
CHKD. BY DATE COMPARISON OF ALTERNATIVE CONFIGURATIONS JOB NO. 1317

I Watershed "X" easterly to Carnadero Creek #67,366
Watersheds "A" & "B" easterly to Carnadero Creek along Mesa Road 63,102
130,468
Plus 25% 32,617
163,085
R.O.W. 10.01 Acres @ $8,000 80,080
Total # 243,165

II Watershed "X" easterly to Carnadero Creek #67,366
Watersheds "A" & "B" easterly along Mesa Road, then south to Reach 3 * 62,412
129,778
Plus 25% 32,445
162,223
R.O.W. 13.32 Acres @ $8,000 106,560
Total * # 268,783

* NOT INCLUDING INCREASES IN COSTS OF REACHES 3, 4, AND 5

III Watershed "X" easterly to Carnadero Creek #67,366
Watersheds "A" & "B" northerly to join Watershed "X" alignment # 21,233
88,599
Plus 25% 22,150
110,749
R.O.W. 8.02 Acres @ $8,000 64,160
Total # 174,909

IV Watershed "X" easterly, then southerly to Mesa Road, then easterly to Carnadero Creek
Watersheds "A" & "B" easterly along Mesa Road to join watershed "X" alignment # 120,327
Plus 25% 30,082
150,409
R.O.W. 10.71 Acres @ $8,000 85,680
Total # 236,089

CONF. II IS THE 2ND PROG. RPT. ALIGNMENT

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 12-10-68 SUBJECT REACHES 1 & 2 SHEET NO. 404 OF
CHKD. BY DATE COMPARISON OF ALTERNATIVE JOB NO. 1317
CONFIGURATIONS

V Watershed "X" easterly, then southerly to Mesa Road, then southerly to Reach 3 * Watersheds "A" & "B" easterly along Mesa Road to join Watershed "X" alignment $140,230

Plus 25% 35,058

$175,288

R.O.W. 14.22 Acres @ $8,000 $113,760

Total * $289,048

* NOT INCLUDING INCREASES IN COSTS OF REACHES 3, 4, AND 5

VI Watershed "X" south along Expressway to Mesa Road & Watersheds "A" & "B", then X + A+B east along Mesa Road to Corradeo

$ 83,080

Plus 25% $ 20770

103,850

R.O.W. 7.69 Acres @ $ 8,000 61,520

Total $ 165,370

LINED OPEN CHANNEL

$Q = 250$ cfs $b = 8$ $S = .05$ $n = .014$ $z = 0$

$$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{250 \times .014}{256 \times .2236} = \frac{3.5}{57.24} = .06115$$

$\frac{D}{b} = .165$ $D = 8 \times .165 = 1.32'$ $A = 8 \times 1.32 = 10.56$ sq ft

$V = \frac{Q}{A} = \frac{250}{10.56} = 23.67$ fps $\frac{V^2}{2g} = 8.70$ $q = \frac{250}{8} = 31.25$

$D_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{30.33} = 3.12'$ $H_m = 1.5 D_c = 4.68'$

$$F_1 = \frac{V_1}{\sqrt{g D_1}} = \frac{23.67}{\sqrt{32.2 \times 1.32}} = \frac{23.67}{\sqrt{42.50}} = 3.63$$

$D_2 = 3.77'$ From Fig. 12, "Hydr. Design of Stilling Basins and Energy Dissipators", USBR,

For a Type IV Basin $\frac{L}{D_2}$ for $F = 3.6$ is about 5.6

$5.6 \times 3.77 = 21.1'$ USE A 30' Long Basin

RCP

$Q = 250$ cfs $S = .05$ $n = .013$

Investigate $\frac{D}{d} = .94$ $K' = .498$

$$d^{8/3} = \frac{Qn}{K' S^{1/2}} = \frac{250 \times .013}{.498 \times .2236} = \frac{3.25}{.11135} = 29.187$$

$d = 3.55'$

Try 48" ϕ, open channel

$$K' = \frac{Qn}{d^{8/3} S^{1/2}} = \frac{250 \times .013}{40.3 \times .2236} = \frac{3.25}{9.011} = .3607$$

$\frac{D}{d} = .664$ $D = 2.656'$

Try 42" ϕ, open channel

$K' = \frac{250 \times .013}{28.2 \times .2236} = \frac{3.25}{6.3055} = .515$ and will flow full @ $S = .05$

RCP, Cont'd

42"ϕ RCP Flowing Full $Q=250$ $n=.013$ $S=.05$

$$S^{1/2} = \frac{Qn}{.463 d^{8/3}} = \frac{250 \times .013}{.463 \times 28.2} = \frac{3.25}{13.06} = .24885$$

$S = .061926$

Check 42"ϕ RCP for $S=.06$

$$K' = \frac{Qn}{d^{2.35} S^{1/2}} = \frac{250 \times .013}{28.2 \times .2495} = \frac{3.25}{6.9076} = .4705$$

$\frac{D}{d} = .835$ $D = 3.5 \times .835 = 2.92'$

$A = cd^2 = .7005 \times 3.5^2 = 8.58 ft^2$ $V = \frac{250}{8.58} = 29.14$ fps $\frac{V^2}{2g} = 13.19'$

$D + h_v = 16.11'$

$$F_1 = \frac{V_1}{\sqrt{g D_1}} = \frac{29.14}{\sqrt{32.2 \times 2.92}} = \frac{29.14}{\sqrt{94.02}} = \frac{29.14}{9.696} = 3.01$$

For a Type IV Basin, $\frac{L}{D_2}$ for $F=3.0$ is about 5.25

$5.25 \times 3.77 = 19.8'$ USE A 30' LONG BASIN + 42"ϕ RCP

UNLINED CHANNEL WITH DROPS

Try 3 – 5' Drops

Ref.: § 15-15, Chow, "Open Channel Hydraulics"

$b=8'$ $d_c = 3.77$ $z=2$ top width $= 8 + 4 \times 3.77 = 23.08'$

$w_{ave} = \frac{8 + 23.08}{2} = 15.54'$ LET $q = \frac{250}{15.54} = 16 d_s$

$$D = \frac{q^2}{g h^3} = \frac{16^2}{32.2 \times 5^3} = \frac{256}{32.2 \times 125} = \frac{256}{4025} = .0636$$

$L_d = 4.30 h D^{.27} = 4.30 \times 5 \times .475 = 10.2'$

$y_p = 1.00 h D^{.22} = 5 \times .545 = 2.725'$

$y_1 = 0.54 h D^{.425} = .54 \times 5 \times .309 = 0.834'$

$y_2 = 1.66 h D^{.27} = 1.66 \times 5 \times .475 = 3.94'$

CONTINUING ON OUR AVE. WIDTH ASSUMPTION, $V = \frac{q}{d} = \frac{16}{1.834} = 19.2$ fps

$$F_1 = \frac{V_1}{\sqrt{g D_1}} = \frac{19.2}{\sqrt{32.2 \times 1.834}} = \frac{19.2}{\sqrt{26.9}} = 3.7$$

For a "natural" jump $\frac{L}{D_2}$ for $F=3.7$ is about 5.7

$L = 5.7 \times 3.77 = 21.5'$ $L_d + L = 10.2 + 21.5 = 31.7$, USE 35'

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 12-2-68 SUBJECT REACH 1 SHEET NO. 407 OF
CHKD. BY DATE MESA ROAD ALIGNMENT JOB NO. 1317
Struct. Quantities Conf I, IV, and V

Lined Open Channel



8" Thick

$3 \times 8 = 24'$ $24' \times \frac{8}{12} = 16$ CF/LF

23+30 Outlet exist. RCB
20+80 End new channel
250' + 30' Dissipator = 280 LF

$\frac{16 \times 280}{27} = 166$ CY Struct. PCC

Let Str. Exc. be $15 \times x = 4$ CF/LF $\frac{4 \times 280}{27} = 41$ CY
Let Backfill be the same
Channel Exc. $10'w \times 280'L \times 9'H(ave) \times \frac{1}{27} = 933$ CY

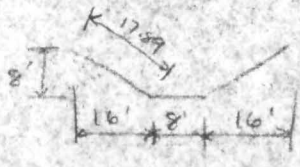
42" ϕ RCP

250 LF RCP
30 LF Dissipator

$30 \times 16 \times \frac{1}{27} = 18$ CY Struct. PCC
Str. Exc. $= 4 \times 30 \times \frac{1}{27} = 4$ CY
Let Backfill be the Same
Exc. $= 10 \times 30 \times 10 \times \frac{1}{27} = 111$ CY

3 - 5' Drops

Each Drop:



$\sqrt{8^2 + 16^2} = \sqrt{320} = 17.89'$
$17.89 + 8 + 17.89 = 43.78'$



$.8 \times 7 + 3 \times 1.2 = 5.6 + 3.6 = 9.2$ CY
$9.2 \times 40 \times \frac{1}{27} = 13.6$, use 14 CY Str. PCC

Use a total of 50' of 6" channel lining:
$50' \times 43.78' \times .5' \times \frac{1}{27} = 41$ CY Lining
$2 \times 43.78' \times 3' \times 1' \times \frac{1}{27} = 10$ CY Cutoffs
51 CY Lining PCC

Str. Exc.: $2 \times 43.78' \times 3' \times 2' \times \frac{1}{27} = 29$ CY cutoffs
$43.78' \times .5' \times 1' \times \frac{1}{27} = 8$ CY Drop Wall
37 CY Str. Exc.

Backfill: $2 \times 43.78' \times 3' \times 2' \times \frac{1}{27} = 19$ CY
$43.78' \times 2' \times 1' \times \frac{1}{27} = 3$ CY
22 CY Backfill

Channel Exc. See next sheet

BY A.W DATE 12-2-68 SUBJECT REACH 1 SHEET NO. 40 OF
CHKD. BY DATE MESA ROAD ALIGNMENT JOB NO. 1217
STRUCT. QUANTITIES, COSTS
CONF I, II, and V

3-5' Drops, Cont.

Sta	O.G.	IE	D	Area, □' Cut	Fill
20+50	189.9	178.607	11.23	342	0
20+80	190.7	178.738	11.96	382	0
20+80	"	183.738	6.96	153	36
21+80	194.9	183.976	10.42	301	0
21+80	"	188.976	5.92	102	104
22+80	198.6	189.214	9.39	251	0
22+80	"	194.214	4.39	74	160
23+30	200.0	199.383	5.67	110	92
				5,810 CF	1,380 SF
				2,067 CY	493 CY

Costs from 20+50 to 23+30

		Lined Open Channel		42"ϕ RCP		3-5' Drops	
Canal Exc.	$1.20	933 CY	$1120	111 CY	$133	2069 CY	$2,480
Canal Emb.	0.80	—	0	—	0	493 CY	394
Str. Exc.	4.00	41 CY	164	4 CY	16	111 CY	444
Str. Backfill	6.00	41 CY	246	4 CY	24	66 CY	396
Lining Concrete	60.00	—	0	—	0	153 CY	9,180
Str. Concrete	90.00	166 CY	14,940	18 CY	1,620	42 CY	3,780
42"ϕ RCP	31.50	—	0	250 LF	7875	—	0
			$16,470		$9,668		$16,674

USE 42"ϕ RCP X 250 LF plus 8'W x 8'D x 30 LF DISSIPATOR

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BY AJW1 DATE 12-3-68 SUBJECT REACH 1 & REACH 2 SHEET NO. 4 OF
CHKD. BY DATE MESA ROAD ALIGNMENT JOB NO. 1317
Earthwork and Costs

CONF. I, CONF IV

STA.	Top Bern	O.G.	I.E.	D_1	D_2	CUT	FILL
0+00	189.2	175.00	175.00				
0+40		175.05	175.05	0	14.15	0 SF	1225 SF
0+70		189.2	175.10	14.10	0	510	0
2+00		189.2	175.27	13.93	0	500	0
4+00		187.4	175.55	11.85	1.80	376	67
6+00		185.8	175.82	9.98	3.40	279	148
8+00		186.4	176.10	10.30	2.80	295	115
10+00		186.0	176.37	9.63	3.20	263	137
12+00		185.0	176.64	8.36	4.20	207	197
14+00		186.5	177.12	9.38	2.70	251	110
16+00		186.3	177.60	8.70	2.90	221	121
18+00		186.4	178.07	8.33	2.80	205	115
20+50	189.2	189.2	178.67	10.53	0	306	0
						586,075 CF	223,250 CF
						21,706 CY	8,269 CY

S = .0137

S = .0238

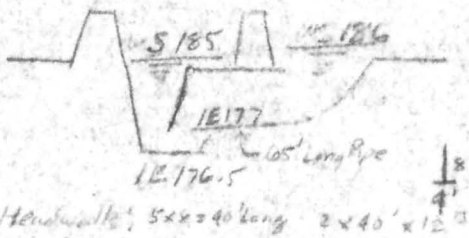
$CUT = 2D_1^2 + BD_1 = 2D_1^2 + 8D_1$

$FILL = 2(2D_2^2 + 6D_2) = 4D_2^2 + 30D_2$

(T.B.) - (O.G.) = D_2

(O.G.) - (I.E.) = D_1

FLAP GATE STRUCTURE



H = 1' = 2h_v h_v = 0.5' V = 5.67 fps

A = Q/V = 750/5.67 = 132.0' 5-72" RCP = 141.35 □'

72" ϕ Flap Gate	EA	1	6,000
72" RCP	325 LF	72.00	23,400
Str. Conc.	36 CY	90.00	3,240
Str. Exc. & Backfill	LS		200
			32,840

Excavation	21,817 CY	1.20	26,180	
Embankment	8,269 CY	0.80	6,615	
Str. Exc.	4 CY	4.00	16	
Str. Backfill	4 CY	6.00	24	
Str. Concrete	18 CY	90.00	1,620	
42" ϕ RCP	250 LF	31.50	7,875	95,942
Flap Gate Structure	LS		32,840	-32,840
Outlet Structure	LS		20,772	63,102
Total, Conf. IV			95,942	67,366
				130,468 Total for Reach 1

$Q = 250 cfs$ $H = 2' \pm$ $L = 50'$

Let Entrance + Exit Losses = $1.15 \Delta h_v$

$V_1 = 4.27$ $h_{v_1} = 0.28'$

Try 72"ϕ RCP $A = 28.27$ $V = \frac{250}{28.27} = 8.85$ $h_{v_2} = 1.21$

$\Delta h_v = 1.21 - 0.28 = 0.93$

$S = \left(\frac{Qn}{.462 d^{8/3}}\right)^2 = \left(\frac{250 \times .013}{.462 \times 119}\right)^2 = .00348$

$SL = 0.17$
$1.15 \Delta h_v = 1.07$
$H = 1.24'$

Try 60"ϕ RCP $A = 19.63$ $V = \frac{250}{19.63} = 12.74$ $h_{v_2} = 2.52'$

$\Delta h_v = 2.52 - .28 = 2.24$

$S = \left(\frac{250 \times .013}{.462 \times 73.1}\right)^2 = .00923$

$SL = .46$
$1.15 \Delta h_v = 2.58$
$3.04'$

Try 66"ϕ RCP $A = 23.76$ $V = 10.52$ $h_{v_2} = 1.71$

$\Delta h_v = 1.71 - .28 = 1.43$

$S = \left(\frac{250 \times .013}{.462 \times 94.3}\right)^2 = .00554$

$SL = .28$
$1.15 \Delta h_v = 1.65$
$1.93'$

USE 60"ϕ x 50LF RCP

Outlet IE	170+95	176.246
Inlet IE	171+45	176.365
	171+85	176.460 + 3.04' = 179.500

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BY AJW DATE 12-5-68 SUBJECT REACH 1 SHEET NO. 911 OF
CHKD. BY DATE From Expressway along Mesa Rd, then JOB NO. 1317
N to Expr. South to Castro Valley Road
CONF II

COSTS (SEE Mesa Rd. Alignment Calcs. for some items)

Excavation	35,036 CY	$1.20	$42,043
Embankment	765 CY	0.80	612
Str. Exc.	74 CY	4.00	296
Str. Backfill	46 CY	6.00	276
Lining Concrete	82 CY	60.00	4,920
Str. Concrete	48 CY	90.00	4,320
42" ϕ RCP	230 LF	31.50	7,245
60" ϕ RCP	50 LF	54.00	2700
			$62,412

Mesa Road Culvert



$\sqrt{8^2+16^2} = \sqrt{320} = 17.9'$ $17.9+8+17.9 = 43.8'$

$8'+8'+8' = 24'$ $(43.8+24)\frac{1}{2} = 67.8/2 = 33.9'$

$2\times3.77+8+2\times3.77 = 23.08$ $(23.08-8)/2 = 15.08/2 = 9.04$

$\frac{9.04}{\tan 30^\circ} = 15.6'$ $\frac{9.04}{\tan 22.5^\circ} = 21.8'$

Use 20' transition W's and 30' D/S

$50' \times 33.9' \times .5' \times \frac{1}{27} = 31.4$ CY Lining PCC

$7' \times .75' + 3' \times 1.2' = 5.25 + 3.6 = 8.85$ SF

$8.85 \times 10' \times 2 \times \frac{1}{27} = 6.6$ CY Str PCC in Headwall

$2\times43.8' \times 1' \times 3' \times \frac{1}{27} =$ 9.7 CY in Cutoffs

16.3 CY Str. PCC 16+18 = 34

Str. Exc. $2\times43.8' \times 3' \times 1' \times \frac{1}{27} = 29$ CY Cutoffs

$2\times10' \times 5' \times 1' \times \frac{1}{27} =$ 4 H.W.'s

33 CY +4 = 37

Backfill $2\times43.8' \times 3' \times 2' \times \frac{1}{27} = 19$ CY Cutoffs

$2\times10' \times 2' \times 1' \times \frac{1}{27} =$ 1 H.W.

20 CY +4 = 24

	Str Exc.	Str Backfill	Lining PCC	Str PCC
2' Drop - See 5' Drop for Reach 1A	37	22	51	14
Dissipator - See Reach 1 Mesa Rd Align.	4	4	0	18
Mesa Road Culvert	33	20	31	16
	74 CY	46 CY	82 CY	48 CY

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BY A. Hill DATE 12-5-68 SUBJECT REACHES 1 & 2 SHEET NO. 412 OF

CHKD. BY DATE CASTRO VALLEY ROAD TO MESA ROAD JOB NO. 1317

TO EXPRESSWAY CONF. II and IV

REACH 1 ONLY (CONF II)

STA	O.G	I.E.	d	CUT	FILL
127+70	173.00	164.000	9.00	234 CF	0 CF
130+00	172.80	164.50	8.30	204	0
132+00	172.20	164.98	8.22	201	0
134+00	173.70	165.45	8.25	202	0
136+00	174.20	165.93	8.27	203	0
138+00	175.10	166.40	8.70	221	0
140+00	175.60	166.88	8.72	222	0
142+00	176.00	167.36	8.64	218	0
144+00 =	177.00	167.832	9.17	242	0
DROP	177.00	169.832	7.17	160	28
146+00	178.20	170.31	7.89	188	3
148+00	178.50	170.78	7.72	181	9
150+00	179.00	171.26	7.74	182	8
152+00	179.50	171.74	7.76	183	7
154+00	180.00	172.21	7.79	184	6
156+00	180.60	172.69	7.91	188	3
158+00	181.00	173.16	7.84	186	5
160+00	181.00	173.64	7.36	167	21
162+00	181.90	174.12	7.78	187	7
164+00	182.30	174.57	7.71	181	9
166+00	182.60	175.07	7.53	174	15
167+00	184.00	175.31	8.69	221	0
168+00	186.00	175.54	10.46	303	0
169+00	186.60	175.78	10.82	321	0
170+00	187.60	176.02	11.58	361	0
170+95 =				427	0
Start Cub.	189.00	176.246	12.75	0	0
191+45 =				0	0
End Cub.	188.50	176.365	12.15	392	0
171+85	187.50	179.500	8.00	192	0
172+58	188.50	179.65	8.85	227	0
173+50	191.40	179.893	11.51	357	0
				945,968 CF	20,650 CF
				35,036 CY	765 CY

S = .00238; 2' Drop; Invert 8', Berm 15', Z = 2; Gross Depth = 8'

REACH 2 (CONF II)

I.E.	d	CUT	FILL
164.000	9.00	234 CF	0 CF
164.29	8.51	213	0
164.56	8.64	218	0
164.84	8.76	228	0
165.11	9.09	238	0
165.38	9.72	267	0
165.66	9.99	277	0
165.93	10.07	282	0
166.206	10.79	319	0
170.206	6.79	147	50
170.48	7.72	181	15
170.75	7.75	182	14
171.03	7.97	191	7
171.30	8.20	200	0
171.58	8.42	209	0
171.85	8.75	223	0
172.12	8.88	229	0
172.40	8.60	217	0
172.67	9.23	244	0
172.95	9.35	250	0
173.22	9.38	251	0
173.36	10.64	312	0
173.99	12.57	413	0
173.63	12.97	440	0
173.77	13.83	493	0
	15.10	577	0
173.998	X	0	0
	X	0	0
174.178	14.32	524	0
178.593	8.91	230	0
		1,086,940 CF	12,200 CF
		40,257 CY	452 CY

S = .00137; 4' Drop; Invert = 8'; Z = 2; Berm 12'; Gross Depth = 8.21'

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BY AJW DATE 12-2-68 SUBJECT REACH 1A HYDRAULICS SHEET NO. 413 OF
CHKD. BY DATE North of Mesa Rd. Alton JOB NO. 1317
Conf III

REF., 2ND PROGRESS REPORT:

Reach 1 drains watersheds A and B
Reach 2 drains Reach 1 and an additional 503 acres

Let us try moving areas A & B north to a channel lining up with the 6'x6' RCB under the expressway

The two trial lines 1B and 1C should be adequate for Reach 1; However, we must modify Reach 2 d/s of Reach 1

		50 Yr.	100 Yr	100 Yr x 80%
Reach	2	510	730	1000
Reach	1	155	185	250
Reach	1A	355	545	750
Reach	3	450	550	700

Use Reach 3 $b=8'$ $d=8'$ $S=.00159$

The 42"ϕ RCP quantities for lines 1B and 1C may be taken from the profiles and the cells for the Reach 1 Mesa Road Alignment

REACH 1A: RCP

Try 72"ϕ RCP $\frac{D}{d}=.9$ $n=.013$

$$S^{1/2}=\frac{Qn}{d^{8/3}k'}=\frac{750\times.013}{119\times.494}=\frac{9.75}{58.786} \qquad S=.0275^{12},\ \text{use } .0275$$

Try 66"ϕ RCP $\frac{D}{d}=.9$ $n=.013$

$$S^{1/2}=\frac{9.75}{94.3\times.494}=\frac{9.75}{46.58} \qquad S=.043814$$

This could run to an 18' cut so Use 72"ϕ RCP

Using 72"ϕ RCP, $A=cd^2=.785\times36=26.820'$

$$V=\frac{Q}{A}=\frac{750}{26.82}=27.96 \qquad D=.9\times6=5.4'$$

$$F_1=\frac{V_1}{\sqrt{gD_1}}=\frac{27.96}{\sqrt{32.2\times5.4}}=\frac{27.96}{\sqrt{179}}=\frac{27.96}{13.2}=2.1$$

$\frac{L}{D}=4.5$ $L=4.5\times6'=$ [illegible] Use 4' D

LINED CHANNEL

$b=8'$ $d=8'$ $n=.014$ $S=.014$ $z=0$ $Q=750$

$$k' = \frac{Qn}{b^{8/3}S^{1/2}} = \frac{750 \times .014}{256 \times .1183} = \frac{10.5}{30.28} = .3468 \quad \frac{D}{b} = .565 \quad D = 4.52'$$

$A = 36.16^{\square'}$ $V = \frac{Q}{A} = \frac{750}{36.16} = 20.74$

$$F_1 = \frac{V_1}{\sqrt{gD}} = \frac{20.74}{\sqrt{32.2 \times 5.4}} = \frac{20.74}{\sqrt{174}} = \frac{20.74}{13.2} = 1.57$$

$\frac{L}{D_2} = 3.8$ $L = 20.5'$ Use 30' Dissipator

Same for $S=.0275$ USE $S=.0275$

$$k' = \frac{10.5}{2560 \times .1655} = \frac{10.5}{42.44} = .2474 \quad \frac{D}{b} = .44 \quad D = 3.52'$$

$A = 28.16^{\square'}$ $V = \frac{750}{28.16} = 26.63$ $F_1 = \frac{26.63}{13.2} = 2.02$

$\frac{L}{D_2} = 4.3$ $L = 23.2$ USE 30' Dissipator

DROPS

Try 4-5' Drops Essentially identical to those for Reach 1

EXCAVATION QUANTITIES FOR REACH 1A

			WITH DROPS			w/o DROPS		
STA	O.G.	I.E.	D	CUT	FILL	D	CUT	FILL
13+40	191.00	182.64	8.36	207	0	8.36	207	0
15+00	192.6	182.89	9.71	266	0	9.71	266	0
17+00	195.5	183.21	12.29	400	0	12.29	400	0
17+00	195.5	188.21	7.29	165	23	—	—	—
18+30	197.0	188.42	8.58	216	0	13.58	477	0
20+00	199.5	188.69	10.81	320	0		161,445 CF	0
20+00	199.5	193.69	5.81	114	85		5,979 CY	0 CY
23+00	203.5	194.17	9.33	249	0			
23+00	203.5	199.17	4.33	72	164			
26+00	209.0	199.64	9.36	250	0			
26+00	209.0	204.64	4.36	73	162			
26+60	210.0	204.74	5.26	97	112			
				282,615 CF	47,065 CF			
				10,467 CY	1,743 CY			

72"ϕ x 780 LF RCP

26+40
13+60
780



8" T.C.

72" RCP	780	LF
Str. PCC	18	CY
Str. Exc.	4	CY
Str. Backfill	4	CY
Excavation	147	CY

Dissipator: $2 \times 8' \times \frac{2}{3}' = 16$ CF/LF $16 \times 30 \times \frac{1}{27} = 18$

Str. Exc.: $\frac{1}{2} \times 8' = 4$ CF/LF $4 \times 30 \times \frac{1}{27} = 4$

Backfill: Assume Same

Exc.: $12 \times 11 \times 30 \times \frac{1}{27} = 147$

LINED OPEN CHANNEL

Lengths same as RCP above

780
+30
810

$16 \times 810 \times \frac{1}{27} = 480$

$4 \times 810 \times \frac{1}{27} = 120$

Exc.	3820	CY
Str. Exc.	120	CY
Backfill	120	CY
Str. PCC	480	CY

Excavation varies from 6 to 15', say 11' ave.

$2 \times 0.7 \times 8 = 9.33$, say $12 \times 11 \times 780 \times \frac{1}{27} = 3813$

4 - 5' DROPS

(See Reach 1, Mesa Road Alignment, quant. calcs.)

4×37
4×22
4×51
$4 \times 14 =$

Str. Exc.	148	CY
Backfill	88	CY
Lining PCC	204	CY
Str. PCC	56	CY

McCREARY · KORETSKY · ENGINEERS

BY AJK DATE 12-3-68 SUBJECT REACHES 2, 1B, & 1C SHEET NO. 416 OF
CHKD. BY DATE Earthwork Quantities JOB NO. 1317
CONF. III

STA	IE	REACHES 2, 1B				REACH 1C			
		O.G.	D	CUT	FILL	O.G.	D	CUT	FILL
ON	180.8								
0+40	180.85		0	0	0				
0+60	180.88	190.0	9.12	239	0				
0+70	180.90	191.0	10.10	285	0				
2+00	181.07	191.2	10.13	286	0				
4+00	181.35	191.4	10.05	282	0				
6+00	181.62	191.6	9.98	279	0				
8+00	181.90	190.6	8.70	221	0				
10+00	182.17	190.8	8.63	218	0				
12+00	182.44	190.8	8.36	207	0				
13+40	182.64	191.0	8.36	207	0				
				320,405 CF	0 CF				
				11867 CY	0 CY				
13+40	182.64	191.0	8.36	207	0				
16+00	183.25	189.8	6.55	138	52				
18+00	183.73	188.7	4.97	89	128				
20+00	184.21	188.2	3.99	64	185				
21+80	184.64	187.6	2.96	41	253				
22+00	184.68	188.0	3.32	49	228				
22+80	184.87	194.6	9.73	267	0				
				105,840 CF	109,410 CF				
				3,920 CY	4052 CY				
22+80	184.87	194.6	9.73	267	0	194.6	9.73	267	0
24+00	185.16	189.6	4.44	75	157	191.6	6.44	134	57
25+00	185.40	194.0	8.60	217	0	195.8	10.40	300	0
26+00	185.63	192.4	2.77	38	266	193.2	7.57	175	14
27+00	185.87	197.4	1.53	17	362	196.0	10.13	286	0
28+00	186.11	193.4	1.29	14	381	198.2	12.09	389	0
29+00	186.35	192.4	2.05	25	320	192.0	5.65	109	93
30+00	186.59	190.2	3.61	55	209			151,210 CF	12,320 CF
31+10	186.85	194.0	7.15	159	28			5,600 CY	456 CY
				69,890 CF	193,655 CF				
				2,589 CY	6,432 CY				

REACH 2

REACHES 1B & 1C

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BY AJN DATE 12-3-68 SUBJECT N. of Mesa Rd. Alignment SHEET NO. 417 OF
CHKD. BY DATE Costs JOB NO. 1317
CONF III

LINE 1B vs LINE 1C, STA 13+40 to D/S END EXISTING 6'0"x4'H R.C.B

		LINE 1B		LINE 1C	
Excavation	$1.20	6620 CY	$7,944	9,631 CY	$11,557
Embankment	0.80	10,484 CY	8,387	4,508 CY	3,606
Str. Exc.	4.00	4 CY	16	4 CY	16
Str. Backfill	6.00	4 CY	24	4 CY	24
Str. Concrete	90.00	18 CY	1,620	18 CY	1,620
42"ϕ RCP	31.50	130 LF	4,095	140 LF	4,410
			$22,086		$21,233

USE LINE 1C RATHER THAN 1B – IT PROVIDES SUPERIOR SURFACE DRAINAGE AND COSTS LESS

REACH 1A

		4-5' DROPS		LINED OPEN CHANNEL		72"ϕ RCP	
Excavation	$1.20	10,467 CY	$12,560	9,946 CY	$11,935	6,126 CY	$7,351
Embankment	0.80	1,743 CY	1,394	0 CY	0	0 CY	0
Str. Exc.	4.00	148 CY	592	120 CY	480	4 CY	16
Str. Back.	6.00	88 CY	528	120 CY	720	4 CY	24
Lining Conc.	60.00	204 CY	12,240	0 CY	0	0 CY	0
Str. Conc.	90.00	56 CY	5,040	480 CY	43,200	18 CY	1,620
72"ϕ RCP	72.00					780 LF	56,160
			32,354		56,335		65,171
					-2,955		-2,955
					53,380		62,216

FOR REACH 1A USE THE 4-5' DROPS

780/5,280 x $20,000 = $2,955
Credit for lower maint. due to lined channel @ $20,000 per mile

REACH 2, NORTH OF MESA ROAD ALIGNMENT

Excavation	11,867 CY	$1.20	$14,240	
Outlet Structure	LS		20,772	
			$35,012	

LINE 1C	$21,233	
REACH 1A	32,354	$32,354
REACH 2	35,012	35,012
TOTAL FOR N. of MESA RD. ALIGN. →	$88,599	$67,366

TOTAL FOR WATERSHED X STRAIGHT TO CARN. CREEK

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BY A.J.W. DATE 12-9-68 SUBJECT REACHES 1, 1A, & 2 SHEET NO. A 18 OF
CHKD. BY DATE JOB NO. 1317

CONF IV

REACHES 2 & 1A

STA.	Reach	O.G.	I.E.	D_1	D_2	D	CUT	FILL
0+00	189.2		175.00					
6+40		175.05	175.05	0	14.15		0 CF	1225 CF
8+70		179.2	175.10	14.10	0		510	0
2+00		189.2	175.27	12.93	0		500	0
4+00		182.4	175.55	11.85	1.80		376	67
6+00		185.2	175.82	9.98	3.40		279	148
8+00		186.4	176.10	10.30	2.80		295	115
10+00		186.0	176.37	9.63	3.20		203	137
12+00		185.0	176.69	8.36	4.20		207	197
14+00		186.0	176.96	9.04	3.20		236	137
16+00		186.6	177.28	9.32	2.60		248	105
			177.60	10.0			280	58
18+00		187.6	180.60	7.00	1.60		154	58
20+00		184.2	180.92	7.28	1.00		164	39
22+00	189.2	189.2	181.23	7.77	0		191	0
24+00		190.2	181.55			8.65	219	0
25+90								
9+15		190.6	181.85			8.75	223	0
10+00		190.7	181.99			8.71	221	0
12+00		190.7	182.31			8.49	212	0
14+00		192.6	182.63			8.77	233	0
							789,000 CF	217,975 CF
							29,224 CY	8,073 CY

REACH 2 → REACH 1A

$Cut = 2D_1^2 + 8D_1 = 2D_1^2 + 8D_1$

$Fill = 2(2D_2^2 + 6D_2) = 4D_2^2 + 30D_2$

REACH 1

STA	Cut*	Fill*
12+00	207	197
14+00	251	110
16+00	221	121
18+00	205	115
20+50	306	0
	199,475 CF	91,775 CF
	7,388 CY	3,399 CY
	+ 111	
	7,499 CY	

*From prev. calcs.

Balance of Reach 1A is from CONF. III and includes 4-5' drops

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BY AJW DATE 12-9-68 SUBJECT REACHES 1, 1A, 2 SHEET NO. 419 OF

CHKD. BY DATE JOB NO. 1217

CONF IV

Item	Exc.	Emb.	Str. Exc.	Backfill	Concrete Lining	Concrete Str.
Upper Portion Reach 1A	10,467	1,743	148	88	204	56
Bal. Reach 1A, Reach 2	29,224	8,073	37	22	51	12 ±
Reach 1	7,499	3,399	4	4	0	18
	47,190 cy	13,215 cy	189 cy	114 cy	255 cy	86 cy

			#
Excavation	47,190 CY	1.20	56,628
Embankment	13,215 CY	0.80	10,572
Str. Exc.	189 CY	4.00	756
Backfill	114 CY	6.00	684
Lining Concrete	255 CY	60.00	15,300
Str. Concrete	86 CY	90.00	7,740
42" ϕ RCP	250 LF	31.50	7,875
Outlet Structure	LS		20,772
			# 120,327

$Q = 1000$ cfs $L = 50'$ $n = .013$ $V_2 = 4.98$ $h_{v_2} = 0.39$ $D_2 = 8.22'$

Let $H = sL + 1.15\Delta h_v$

Try 108" ϕ RCP $\frac{D}{d} = \frac{8.22}{9} = .913$ $k' = .496$ $c = .752$

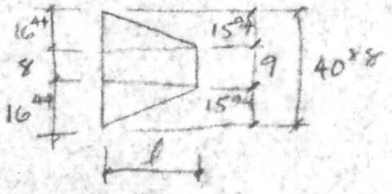
$A = cd^2 = .752 \times 81 = 60.9$ $V = \frac{1000}{60.9} = 16.42$ $h_{v_1} = 4.18$ $\Delta h_v = 4.18 - .39 = 3.79$

$s = \left(\frac{Qn}{k' d^{8/3}}\right)^2 = \left(\frac{1000 \times .013}{.496 \times 350}\right)^2 = .00561$

$sL = .28$

$1.15\Delta h_v = 4.36$

$H = 4.64'$



$\frac{15.94}{\tan 30°} = 27.6$ $\frac{15.94}{\tan 22.5°} = 38.5$ $\sqrt{16.44^2 + 8.22^2} = 18.4'$

$18.4 + 8 + 18.4 = 44.8$

$l = 30'$ W/S and $40'$ D/S

Sta 170+55 IE 173.843

170+95 173.858

+.28

171+45 174.178

171+75 174.219

+4.36a

171+75 IE 178.579

$\perp$ 11' t=12"

5' t=14"

Transition and Headwalls

Str. Exc. $2 \times 44.8 \times 3' \times 3' \times \frac{1}{27} = 29.9$ CY cutoff

$2 \times 13' \times 1.2' \times 7' \times \frac{1}{27} = 8.1$ HW Footings

2×1

38.0 CY

Backfill $2 \times 44.8 \times 3' \times 2' \times \frac{1}{27} = 19.9$ CY cutoff

$2 \times 13' \times 1.2' \times 2' \times \frac{1}{27} = 2.3$ HW Footings

22.2 CY

Lining Conc. $\frac{44.8 + 9}{2} = \frac{53.8}{2} = 26.9'$ $26.9' \times .5' \times 70' \times \frac{1}{27} = 35$ CY

Str. Conc. $2 \times 44.8 \times 3' \times 1' \times \frac{1}{27} = 10.0$ CY Cutoff

$2 \times 13' \times 1.2' \times 5' \times \frac{1}{27} = 5.8$ HW Footings

$2 \times 13' \times 11' \times 1' \times \frac{1}{27} = 10.6$ HW Stems

26.4 CY

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BY AJW DATE 12-6-68 SUBJECT REACHES 1, 1A SHEET NO. 42 OF
CHKD. BY DATE U/S MESA ROAD CULVERT JOB NO. 1317
CONP V

	STA	O.G.	I.E.	D	CUT	FILL
REACH 1	171+25	187.00	178.593	8.41	209 CF	0 CF
	172+00	187.70	178.77	8.93	231	0
	173+00	189.80	179.01	10.79	319	0
	173+40	191.20	179.10	12.10	392	0
					58,180 CF	0 CF
					2,155 CY	0 CY
REACH 1A	171+85	187.00	178.593	8.41	209 CF	0 CF
	174+80	186.80	178.93	7.87	187	4
	176+00	187.30	179.25	8.05	194	0
	178+00	187.60	179.57	8.03	193	0
	180+00	188.00	179.89	8.11	196	0
	182+00	188.80	180.21	8.59	216	0
	184+00	189.40	180.52	8.88	229	0
	186+00	190.40	180.84	9.56	259	0
	188+00	191.30	181.16	10.14	287	0
	189+00	191.70	181.32	10.38	299	0
	190+00	192.60	181.48	11.12	336	0
	191+00	193.60	181.64	11.96	382	0
			181.80	13.20	454	0
5.4' Drop	192+00	195.00	182.20	7.80	184	6
	193+00	196.90	182.36	9.54	258	0
	194+00	197.90	182.51	10.39	299	0
			182.67	11.93	380	0
5.4' Drop	195+00	199.60	193.07	6.53	138	53
	196+00	201.30	193.23	8.07	195	0
	197+00	202.40	193.39	9.01	234	0
			193.55	9.95	278	0
5.4' Drop	198+00	203.50	198.95	4.55	78	151
	199+00	205.00	199.11	5.89	117	81
	200+00	206.70	199.27	7.63	177	12
			199.43	9.07	264	0
5.4' Drop	201+00	209.10	204.83	4.27	71	168
	201+20	211.00	204.94	6.06	122	73
					984,272 CF	29,065 CF
					36,455 CY	1,076 CY

Sideslope = 2:1
Invert = 8' Depth = 8'
Berm = 15'

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BY ADW DATE 12-6-63 SUBJECT REACHES 1, 1A, 2 SHEET NO. 422 OF
CHKD. BY DATE // to Expressway to Castro Valley Rd. JOB NO. 1317
CONF. V

REACH ITEM	Exc.	Emb.	Str. Exc.	Str. Backfill	Lining Concrete	Str. Concrete	42"ϕ RCP	108"ϕ RCP
1 Canal & RCP	2,155						240	
1 Dissipator	111		4	4		18		
1A Canal	36,455	1,076						
1A 4-5'± Drops			148	88	204	60		
2 Canal	40,257*	452						
2 1-4' Drop			37	22	51	13		
2 RCP			38	22	35	26		50
	78,978 CY	1,528 CY	227 CY	136 CY	290 CY	117 CY	240 LF	50 LF

* See Conf. II Calcs.

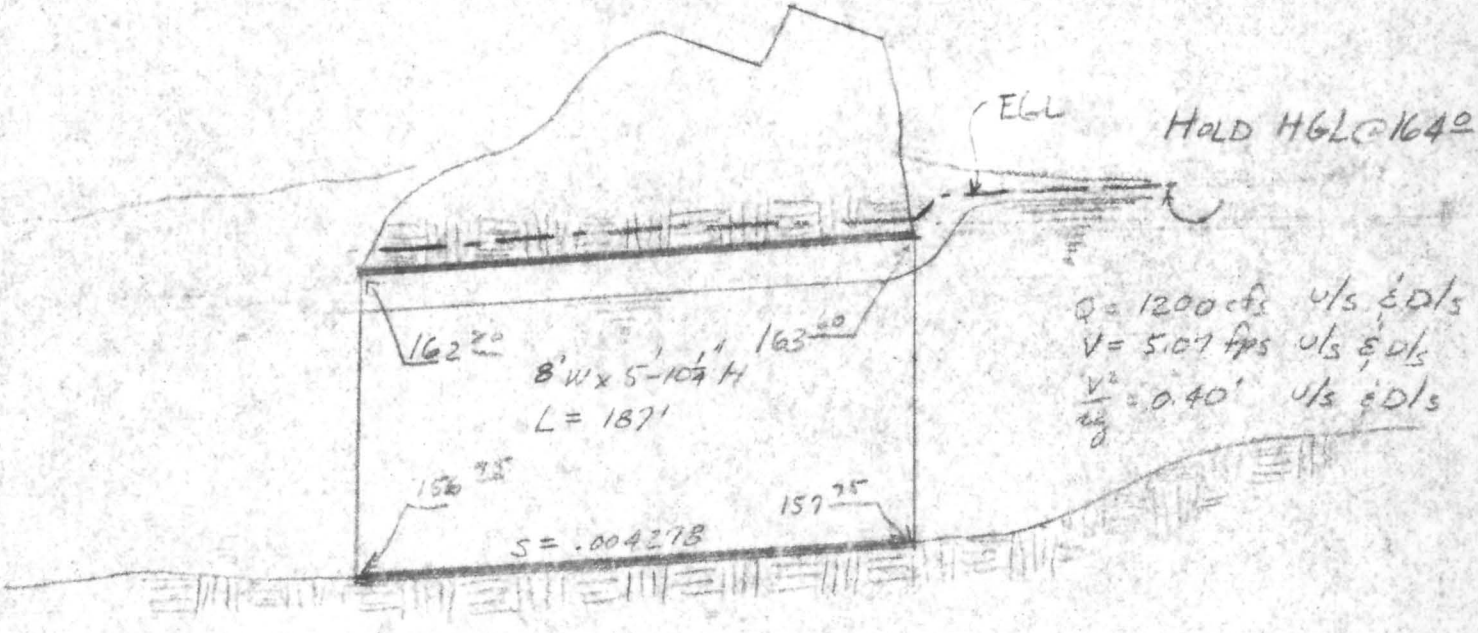
Canal Exc.	78,978 CY	$ 1.20	$ 94,774
Canal Emb.	1,528 CY	0.80	1,222
Struct. Exc.	227 CY	4.00	908
Struct. Backfill	136 CY	6.00	816
Lining Concrete	290 CY	60.00	17,400
Struct. Concrete	117 CY	90.00	10,530
42"ϕ R.C.P.	240 LF	31.50	7,560
108"ϕ R.C.P.	50 LF	140.40	7,020
Total for Configuration V			$ 140,230

SECTION 5

South Unit

Preliminary Route Comparisons

BY AJW DATE 11-19-68 SUBJECT EXISTING RCB u/s UNDER US 101 FIND CAPACITY SHEET NO. 502 OF
CHKD. BY DATE JOB NO. 1317



To make the RCE flow full will raise the water level u/s to above El. 164.4 ~ What is needed is for it to flow nearly full. ACTUALLY, WITH AN ADEQUATE PARALLEL CULV., THE OUTLET IS A WEIR CONTROL

$$Q = \frac{1.486 A R^{2/3} S^{1/2}}{n} = \frac{1.486 A R^{2/3} (.004278)^{1/2}}{.014} = 6.943 A R^{2/3}$$

b	8.00
d	4.00
A	32.00
P	16.00
$R = A/P$	2.00
$R^{2/3}$	1.587
Q	353
$V = Q/A$	11.03
$V^2/2g$	1.89
$d + \frac{V^2}{2g}$	5.89

HGL D/S Inlet	161.25	HGL U/S Outlet	160.25
EGL D/S Inlet	163.64	EGL U/S Outlet	162.34
.5 Δhv	0.75	.2 Δ hv	.30
EGL U/S Inlet	164.39	EGL D/S Outlet	162.54
Canal hv	0.40	Canal hv	.40
HGL U/S Inlet	163.99	HGL D/S Outlet	162.14

164.39
162.54
1.85 Gross Head Loss

Gross Q = 1200
Thru Box −353
Addt'l. Q = 847

TRY 96"ϕ x 160 LF RCP FOR H = 1.85' [PROFILE 1]

$$Q = \frac{.463 d^{8/3} S^{1/2}}{n} = \frac{.463 \times 256 S^{1/2}}{.013} = 9117 S^{1/2}$$

$S^{1/2} = \frac{Q}{9117} = \frac{847}{9117} = .092903$ $S = .008631$ $h_f = 160 \times .008631 = 1.38'$

$V = \frac{Q}{A} = \frac{847}{50.27} = 16.85$ fps $\frac{V^2}{2g} = 4.41'$

Losses are 0.25 Δh_v @ entrance, 0.90 Δh_v @ exit

$\Delta h_v = 4.41 - 0.40 = 4.01$

$(0.25 + 0.90) 4.01 = 4.61$

h_f =	1.38
$1.15 \Delta h_v$ =	4.61
	5.99'

164.00 EGL U/S
5.99 H
158.01 EGL D/S
9.46
148.55 IE D/S

TRY 108"ϕ x 160 LF RCP FOR H = 1.85' [PROFILE 2]

$Q = \frac{.463 \times 350 S^{1/2}}{.013} = 12465 S^{1/2} = 847$ $S^{1/2} = .067950$ $S = .004617$

$h_f = 160 \times .004617 = 0.74'$ $V = \frac{847}{63.62} = 13.31$ fps $\frac{V^2}{2g} = 2.75$

$\Delta h_v = 2.75 - 0.40 = 2.35$

h_f =	0.74
$1.15 \Delta h_v$ =	2.70
	3.44'

164.00 EGL U/S
3.44 H
160.56 EGL D/S
9.46
151.10 IE D/S

TRY 120"ϕ x 160 LF RCP FOR H = 1.85' [PROFILE 3]

$Q = \frac{.463 \times 464 S^{1/2}}{.013} = 16,526 S^{1/2} = 847$ $S^{1/2} = .051253$ $S = .002627$

$h_f = 160 \times .002627 = 0.42'$ $V = \frac{847}{78.54} = 10.78$ fps $\frac{V^2}{2g} = 1.80'$

$\Delta h_v = 1.80 - .40 = 1.40$

h_f =	0.42
$1.15 \Delta h_v$ =	1.61
	2.03'

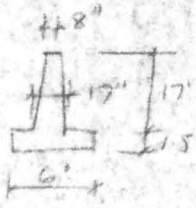
164.00 EGL U/S
2.03 H
161.97 EGL D/S
9.46
152.51 IE D/S

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BY AJW DATE 11-21-68 SUBJECT NEWLIS 101 CULVERT — COMPARISON OF PROFILE / ALTERNATES SHEET NO. 504 OF
CHKD. BY DATE JOB NO. 1317

PROFILE 1, 96"ϕ x 160 LF RCP, Jack





$\frac{8+17}{2\times12} = \frac{25}{24} \approx 1'$ Ave Thickness

$1\times17 + 1.5\times6 = 17+9 = 26^{CF}$ $70\times26 = 1820$

$8'\phi = 50^{CF}$ $50\times\frac{15}{12} = 62.5^{CF}$ $+62$

1758CF

$\frac{1758}{27} = 65.1$ CY

96"ϕ RCP	160 LF	$ 80.64	$ 12,902
Jacking Same	160 LF	200.00	32,000
Headwall PCC	130 CY	90.00	11,700
Total			$ 56,602

PROFILE 1, 96"ϕ x 160 LF, Trench + Detour

Detour involves 45,000 SF Pvt.

$\frac{45,000}{250} = 167$, say 200

$\frac{2}{12}\times45,000\times\frac{150}{2,000} = 562.5$ T

$\frac{6}{12}\times45,000\times\frac{105}{2,000} = 1631.25$ T

Handling Traffic involves 3 changes of striping, one set of barricades, Guardrail next to dtches, Signs 9+9+2=20 $20\times1200 = 24,000$

Signs: 3 Warnings, 3 Curves, 2 S, 4 at T.E.W.S, say 20 Signs

Excavation	200 CY	$ 2.00	$ 400
AC	570 T	12.00	6,840
Base Course	1650 T	3.00	4,950
Striping	25,000 LF	0.05	1,250
Rmv. Same	25,000 LF	0.30	7,500
Guardrail	300 LF	4.00	1,200
Signs	20 Ea	40.00	800
Care of Traffic	1 LS	—	6,000
Subtotal For Detour			$ 28,940
96"ϕ RCP	160 LF	115.20	18,432
Headwall RCP	130 CY	90.00	11,700
Total			$ 59,072

PROFILE 1, 8'W x 6.5'H RCB, Trench + Detour

$8'\phi = 50.27^{CF}$ $8'\times6.5' = 52^{CF}$

$\frac{10}{12}(8.17+7.33)2 = 26.95^{CF}$, use 27^{CF}

$10\times16 = 160^{CF/LF}$ $\frac{160\times160}{27} = 948$ CY

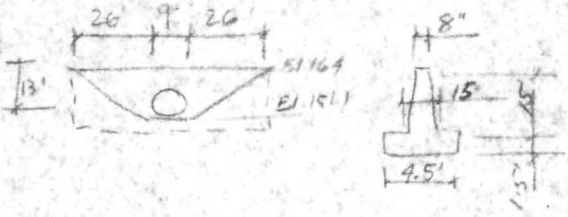
$160 - (9.67\times8.17) = 81^{CY/LF}$

$\frac{81\times160}{27} = 480$ CY

Detour (see above)			$ 28,940
Concrete, RCB*	160 CY	90.00	14,400
Concrete, Headwall	130 CY	90.00	11,700
Str. Exc.	950 CY	4.00	3,800
Backfill	480 CY	6.00	2,880
			$ 61,720

*Based on Calif. Div. Hwys. Std. Design

Profile 2, 108"ϕ x 160 LF RCP, Jack



9'ϕ = 63.62 SF

$\left(\frac{8+15}{2 \times 2}\right) = \frac{23}{24}$, Say 1' Ave. Thickness

1 x 15 x 61 = 915 CF

1.5 x 4.5 x 61 = 412

1327

64 x 15/12 = -80

1247 CF = 461 CY

108"ϕ RCP	160 LF	$ 98.25	$ 15,725
Jacking Same	160 LF	200.00	32,000
Headwall Concrete	92 CY	90.00	8,280
			$ 56005

Profile 2, 108"ϕ x 160 LF RCP, Trench + Detour

Detour (See Prev. Calcs.)			$ 28,940
108"ϕ RCP	160 LF	$ 140.40	22,464
Headwall Concrete	92 CY	90.00	8,280
			$ 59,684

Profile 2, 8' x 8' RCB, Trench + Detour

9'ϕ = 63.62 SF 8' x 8' = 64 SF

4 x 8.83 = 35.32 CF/LF

35.32 x 160 / 27 = 209.3

10 x 13 = 130 SF 130 x 160 / 27 = 770

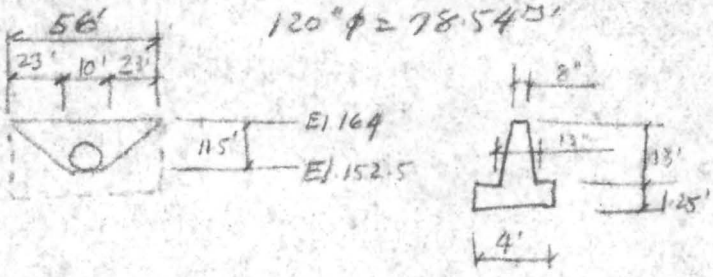
130 - 64 = 66 160 x 66 / 27 = 391

Detour (See Prev. Calcs.)			$ 28,940
Concrete, RCB	210 CY	90.00	18,900
Concrete, Headwall	92 CY	90.00	8,280
Str. Exc.	770 CY	4.00	3,080
Backfill	400 CY	6.00	2,400
			$ 61,600

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 11-21-68 SUBJECT NEW US 101 CULVERT SHEET NO. 506 OF
CHKD. BY DATE COMPARISON OF PROFILE 3 JOB NO. 1317
ALTERNATES

PROFILE 3, 120"ϕ x 160 LF RCP, Jack



120"ϕ = 78.54 SF

$\left(\frac{8+13}{2\times12}\right) = \frac{21}{24} = .875'$ Ave. Thickness

.875 x 13 x 56 = 637 CF
1.25 x 4 x 56 = 280
917
78.54 x 13/12 = 85
832 CF + 27 = 30.8 CY

120"ϕ RCP	160 LF	117.60	$ 18,816
Jacking Same	160 LF	200.00	32,000
Headwall Concrete	62 CY	90.00	5,580
			$ 56,396

PROFILE 3, 120"ϕ x 160 LF RCP, Trench + Detour

Detour (See Prev. Calcs.)			$ 28,940
120"ϕ RCP	160 LF	$ 168.00	26,880
Headwall Concrete	62 CY	90.00	5,580
			$ 61,400

PROFILE 3, 8'W x 10'H RCB x 60 LF, Trench & Detour

10'ϕ = 78.54 SF 8 x 10 = 80 SF
2 x (9+11) = 40 SF/LF
40 x 160 / 27 = 237 CY

10 x 12 x 160 / 27 = 711 CY
10 x 12 − 80 = 40 SF
40 x 160 / 27 = 237 CY

Detour (See Prev. Calcs.)			$ 28,940
RCB Concrete	240 CY	$ 90.00	21,600
Headwall Concrete	62 CY	90.00	5,580
Str. Exc.	720 CY	4.00	2,880
Backfill	240 CY	6.00	1,440
			$ 60,440

120"ϕ RCP Flowing 9' Deep, Q = 847 cfs

D = 9' d = 10' D/d = 0.9 K = .494 $d^{8/3}$ = 464 n = .013

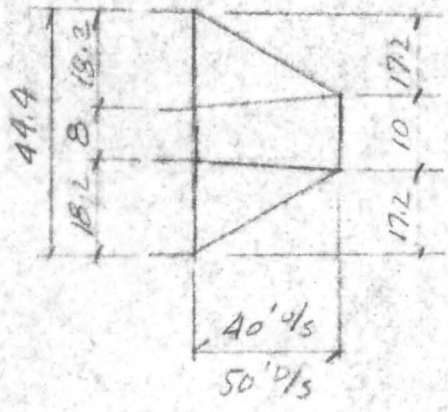
$$Q = \frac{k' d^{8/3} S^{1/2}}{n} = \frac{.494 \times 464\, S^{1/2}}{.013} = 847 \qquad S^{1/2} = \frac{.013 \times 847}{.494 \times 464} = \frac{11.011}{229.2}$$

$S^{1/2}$ = .048041 S = .002308

Flowing full, S = .002627

Therefore, this RCP need not be submerged.

A = 74.5 sf V = 11.37 h_v = 2.01'

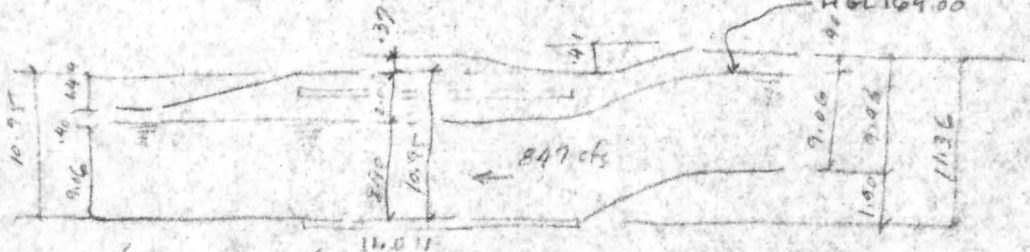


$\frac{17.2}{\tan 20°}$ = 29.8' $\frac{17.2}{\tan 22.5°}$ ≐ 41.5'

91+10 IE 152.50
160 x .00132 = .21
92+70 IE 152.71
40 x .00127 = .05
152.82
1.15 h_v 1.61
93+10 IE 154.43
9.
HGL 163.
0.0
EGL 163.

CHECK FOR 8.9' DEEP

A = 73.8 sf V = 11.48 h_v = 2.05' $0h_v$ = 1.65 $.9ch_v$ = 1.49 .25 h_v = .41 1.15 h_v = 1.90



$$S = \left(\frac{Qn}{k' d^{8/3}}\right)^2 = \left(\frac{847 \times .013}{.491 \times 464}\right)^2 = .002336 \qquad SL = .37'$$

164
- 1.87
162.13
Ent. in Conv.
d/s

Profiles 1, 2, and 3 have a 4' (±) drop @ SPRR

Profile 2 has a 2.55' drop @ Sta 58~

Profile 3 has a 3.96' drop @ Sta 63~

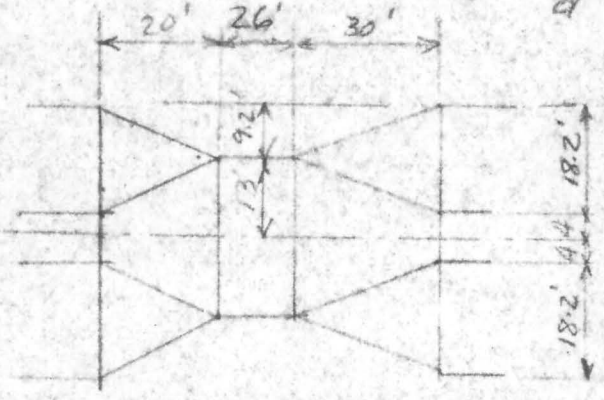
These drops will be similar to the SPRR X'ing in that the F number will be low for b = 8'
Let us widen the channel to obtain an F number on the order of 6

For a 4' drop, $d + h_v = 9.06 + 0.40 + 4 = 13.46'$ Max

Let us maintain a constant depth & velocity as we approach the drop:

$Q = 1200 \quad V = 5.07 \quad A = 236.65 \quad d = 9.06$

$\therefore b = \frac{A}{d} = 26.12'$, use $b = 26'$



$\frac{9.2}{\tan 30°} = 15.9'$

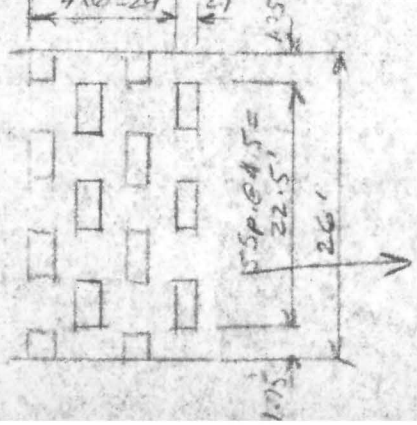
$\frac{9.2}{\tan 22.5°} = 22.2'$



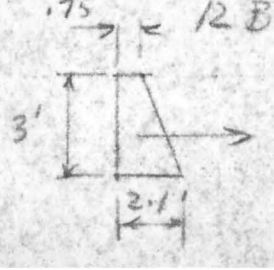
Blocks: From USBR Hyd. Des. of Stilling Basins etc. use Fig. 125:

$q = \frac{1200}{26} = 46$ cfs/ft.

∴ Block Ht. = 3.2', use 3'
Block W. = 1.5 × 3 = 4.5'
Spaces 2 × 3 = 6' ctrs.



This amounts to about
12 Blocks 3' × 4.5' × 1.425' Ave
= 19.24 cf ea.



(Fig. 126)

PROFILES 2 & 3: Drop Structure

Transitions: $\sqrt{18.2^2 + 9.1^2} = 20.35'$

$$\left[\frac{(2\times 20.35+8)+(2\times 9.1+26)}{2}\right] 50 = 2323 \text{ SF} \qquad \frac{2323\times .5}{27} = 43 \text{ cy Lining Pcc}$$

Cutoffs: 4 @ 1'×3'

$[(2\times 20.35+8)+(2\times 9.1+26)]\, 2\times 3 = 557 \text{ CF} = 20.6 \text{ CY}$

Chute: $(2\times 9.1' + 26')1' = 44.2 \text{ CF/LF}$

4 Rows of Blocks 3' high require $4(2\times 3)+2\,1 = 26'$, say 26 LF chute

Cutoffs		557 CF
26 LF Chute @	44.2 =	1149
12 Blocks @	19.25 =	231
		1937 CF = 72 CY Struct. Pa

Structure Exc. includes cutoff walls and some trimming

$\frac{3}{1} \times 557 =$ 1671 CF

$.2'(2233 + 26\times 26) =$ 582

2253 CF = 83 CY, Say 80 CY

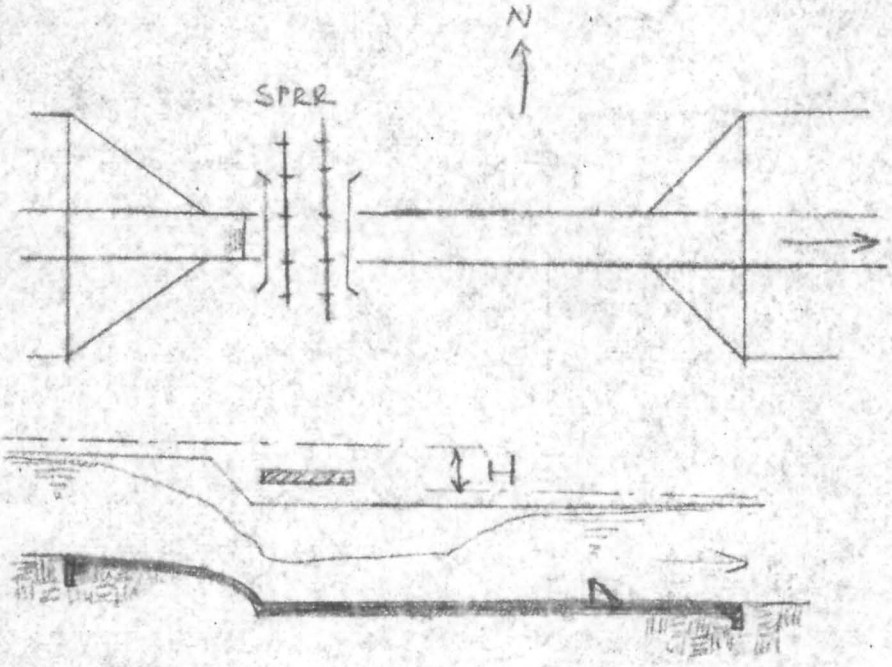
Backfill = , say, 40 CY

Structure Excavation	80 CY	$4	$320
Backfill	40 CY	6	240
Lining Concrete	43 CY	60	2580
Structure Concrete	72 CY	90	6480
			$9620

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BY AJW DATE 11-21-68 SUBJECT SPRR XING- 2ND PROGR. REV. ALIGNMENT SHEET NO. 510 OF

CHKD. BY DATE JOB NO. 1317



PURPOSE: TO GET 1200 cfs UNDER SPRR AND DROP 4'

METHOD:

① Lined Transition from Reach 5 (Unlined) to 8' Wide with Vertical Sides

② Drop IE to lower elev., Lined, b=8', vert. sides

③ Jump, same Section

④ Lined Transition to Reach 5 (unlined) Section

	IE	d	HGL	h_v	EGL
Start Struct.	143.38	9.06	152.44	0.40	152.84
End Trans.	139.53	8.90	148.43	4.41	152.84

① Starts with Reach 5 Canal Section
Ends with . $b=8$ $z=0$

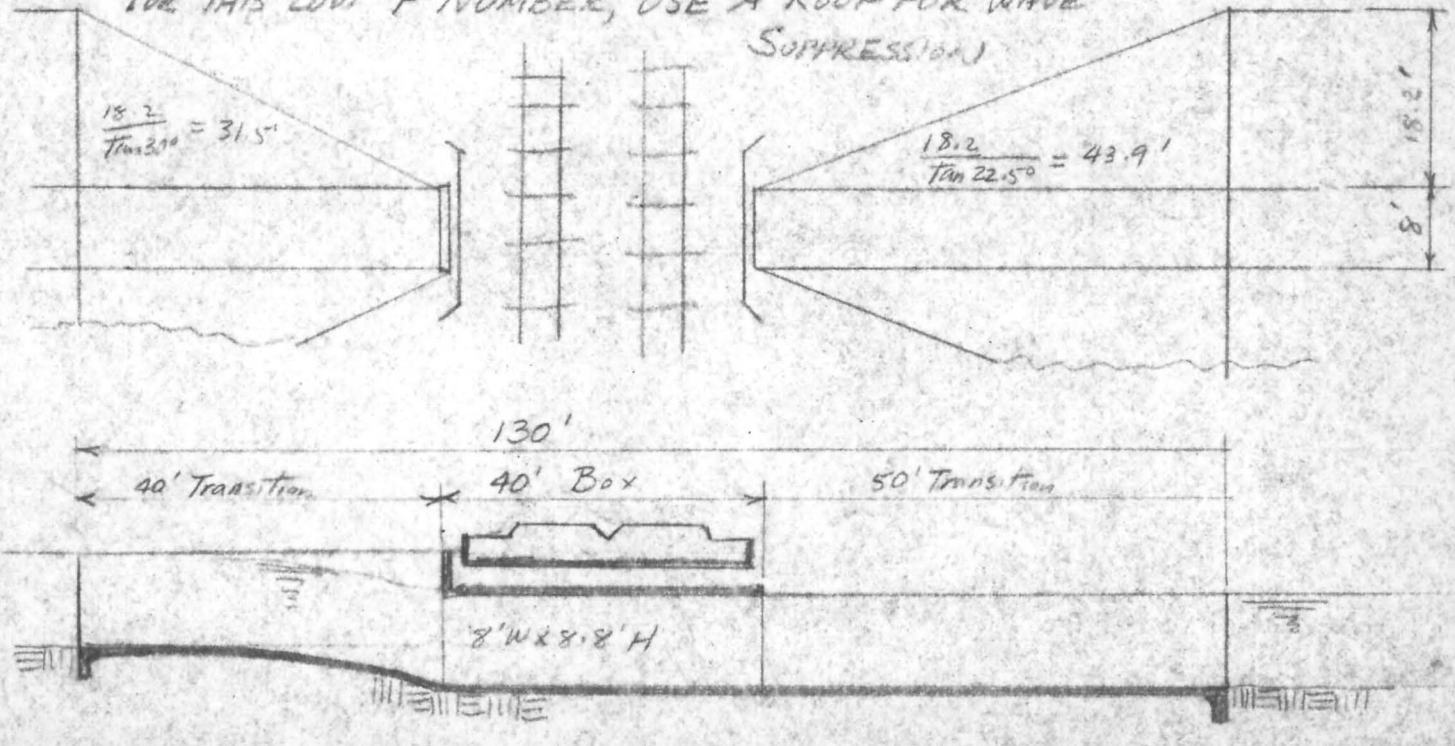
$$q = \frac{120}{8} = 150 \text{ cfs/ft}$$

d	8.5	8.6	8.7	8.8	8.9	9.0
V	17.65	17.49	17.29	17.05	16.85	16.67
h_v	4.84	4.73	4.62	4.52	4.41	4.32
$d+h_v$	13.34	13.33	13.32	13.32	13.31	13.32

②
Note that the end of the transition has an invert nearly equal to the D/s invert of 139.39 — Therefore the transition and the drop-chute may be the same

③ $$F = \frac{V_1}{\sqrt{g D_1}} = \frac{16.85}{\sqrt{32.2 \times 8.9}} = \frac{16.85}{\sqrt{286.6}} = \frac{16.85}{16.93} = 0.995$$

This is a "Form I — Pre Jump" situation
REF.: "Hydr. Design of Stilling Basins & Energy Dissipators", USBR
From Fig. 12 for $F \simeq 1.0$ and a Type III Basin, $\frac{L}{D_2} = 2\pm$
$L = 2D_2 = 2 \times 9.06 = 18.12$ Say 20'
FOR THIS LOW F NUMBER, USE A ROOF FOR WAVE SUPPRESSION



PROFILES 1, 2 AND 3: SPRR CROSSING

The Lined Transition Walls Vary from $\sqrt{18.2^2+9.1^2}$ to 13.1' W/S and 9.1' D/S

$\sqrt{18.2^2+9.1^2} = 20.35'$

$\left(\left(\frac{20.35+13.10}{2}\right)2+8\right)40 = 1658^{\square'}$

$\left(\left(\frac{9.10+20.35}{2}\right)2+8\right)50 = 1873$

$3531^{\square'} \times .5' = 1766\,CF = 65.4\,CY$ Lining

Say 70 CY

The Box is Comparable to an 8'x9' RCB, Say 1' Thick

$2(9+10) = 38^{\square'}/LF \qquad \frac{38\times40}{27} = 56.2\,CY$

Assume 4 Cutoffs 1'x3'

$2(20.35\times2+8)+(9.1\times2+8)+(13.1\times2+8) = 157.8\,LF$

$\frac{1\times3\times157.8}{27} = 17.6$

$56.2 + 17.6 = 73.8$, Say 80 CY Struct Pcc

Struct. Exc.: $\frac{10\times8\times50}{27} = 148\,CY$, Say 150 CY

Backfill: $148 - \left(\frac{8\times5\times50}{27}\right) = 119\,CY$, Say 120 CY

			$
Str. Exc.	150 CY	4	600
Backfill	120 CY	6	720
Lining Concrete	70 CY	60	4200
Structure Concrete	80 CY	90	7200
			$ 12,720

OUTLET STRUCTURE

Transition to 26'w x 9.1' H Rectangular Channel, 20' long

Transition: $\sqrt{9.1^2+18.2^2} = 20.35'$

$\left(\frac{20.35+8+20.35 + 9.1+26+9.1}{2}\right)20 = 929 \text{ CF}$

$\frac{929 \times .5}{27} = 17.2 \text{ CY}$ Lining Conc.

Rect. Channel, use 12" thick, 120' long

$9.1+28+9.1 = 46.2 \text{ SF/LF}$

$120 \times 46.2 = 5,544 \text{ CF}$

Cutoffs, 3'x1':

$(20.35+8+20.35+9.1+26+9.1)3 = 279 \text{ CF}$

$5,823 \div 27 = 216 \text{ CY}$ Struct Conc.

Str. Exc.: $20.35 \times 2 + 8 + 9.1 \times 2 + 26 = 92.9'$

$20' + 120' = 140'$

$140 \times 92.9 = 13006 \text{ SF}$

$.1 \times 13006 = 1301 \text{ CF} = 48 \text{ CY}$

Backfill, Assume 20 CY

Structure Exc.	48 CY	$4	$192
Backfill	20 CY	6	120
Lining Concrete	17 CY	60	1020
Structure Concrete	216 CY	90	19440
			$20,772

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BY A.W DATE 11-19-68 SUBJECT REACH 5, 2ND PROG. RPT. ALIGNMENT SHEET NO. 514 OF
CHKD. BY DATE JOB NO. 1317

STA	O.G.	I.E.	Profile 1 d	Profile 1 Area Cut	Profile 1 Area Fill	Profile 2 d (2.5 lags)	Profile 2 Area Cut	Profile 2 Area Fill	Profile 3 d (1.40 lags)	Profile 3 Area Cut	Profile 3 Area Fill
	S=.00127			□'	□'		□'	□'		□'	□'
91	167.0	148.550	18.45	828	0	15.90	633	0	14.49	536	0
90	165.5	148.423	17.27	735	0	14.72	551	0	13.31	461	0
89+00	165.0	148.296	16.70	691	0	14.15	514	0	12.74	427	0
87+00	164.0	148.042	15.96	637	0	13.41	467	0	12.00	384	0
84+00	163.0	147.661	15.34	593	0	12.79	429	0	11.38	350	0
83+00	162.0	147.534	14.47	535	0	11.92	380	0	10.51	305	0
80+00	161.0	147.153	13.95	494	0	11.30	346	0	9.89	275	0
76+00	160.0	146.645	13.36	464	0	10.81	320	0	9.40	252	0
71+00	159.0	146.010	12.94	441	0	10.44	302	0	9.03	235	2
70+00	158.6	145.883	12.72	425	0	10.17	288	0	8.76	224	11
68+00	158.0	145.629	12.39	405	0	9.82	271	0	8.41	209	23
65+50	157.0	145.312	11.69	367	0	9.14	240	0	7.73	181	49
63+00	156.0	144.999	11.01	331	0	8.46	211	21	7.05 Same as 2	156 Same as 2	78 Same as 2
61+00	155.0	144.740	10.26	293	0	7.71	181	49			
58+00	154.0	144.359	9.69	263	0	7.04 Same as 1	157 Same as 1	76 Same as 1			
56+50	153.0	144.167	8.83	227	8						
55+00	152.0	143.978	8.02	193	37						
54+00	151.0	143.851	7.15	159	74						
SPRR 50+30	150.0	143.381	6.62	141	99						
		139.388	10.61	310	0						
48+30	149.0	139.134	9.87	274	0						
44+50	148.0	138.652	9.35	250	0						
40+50	147.0	138.144	8.86	228	7						
39+00	146.0	137.953	8.05	194	36						
35+50	145.0	137.500	7.49	172	59						
33+00	144.0	137.191	6.84	147	90						
32+50	142.0	137.128	4.87	86	198						
28+00	143.0	136.556	6.44	134	108						
26+00	142.0	136.302	5.70	111	148						
24+50	141.0	136.112	4.89	87	197						
21+00	140.0	135.667	4.33	72	234						
17+50	139.0	135.223	3.78	59	273						
15+00	138.0	134.905	3.10	44	324						
10+00	138.0	134.870	3.73	58	276						

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BY AJW DATE 11-19-68 SUBJECT REACH 5, 2ND PROG. RPT. ALIGNMENT SHEET NO. 515 OF
CHKD. BY DATE JOB NO. 1317

STA.	O.G.	I.E.	Profile 1 d	Profile 1 Area Cut	Profile 1 Area Fill	Profile 2 d	Profile 2 Area Cut	Profile 2 Area Fill	Profile 3 d	Profile 3 Area Cut	Profile 3 Area Fill
9+00	137.0	134.143	2.86	39 □'	343 □'	Same as ↓	Same as ↓	Same as ↓	Same as {	Same as ↓	Same as }
1+80	137.0	133.229	3.77	59	274						
1+50	143.0	133.191	9.81	271	0						
1+30	143.0	133.165	9.84	272	0						
1+00		133.127	0	0	0	0	0	0	0	0	0
0+00		133.000									

0+00 to 58+00	768,875 CF 854,585 CF	768,875 CF 854,885 CF	768,875 CF 854,585 CF
58+00 to 63+00	145,800 0	89,900 25,750	89,900 25,750
63+00 to 91+00	1,405,400 0	988,650 4,625	789,475 29,425
	2,320,075 CF 854,585 CF	1,847,425 CF 883,260 CF	1,648,250 CF 910,060 CF
	85,929 CY 31,662 CY	68,423 CY 32713 CY	61,046 CY 33706 CY

Cut Area = $bd + zd^2$

Fill Area = $2[B(D-d) + z(D-d)^2]$

Vol. = $\Sigma\left(\frac{A_1+A_2}{2}\right)\Delta L$

Berm Width = 15' = B

Invert Width = 8' = b

Depth = 9.10' Min. = D

z = 2

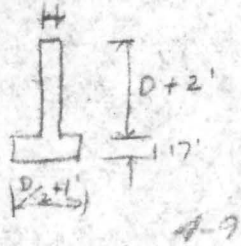
Orig. Ground to Invert = d

Q=1200 cfs For Cond'l, S=.00127 A=236.65 sf, V=5.07 fps $\frac{V^2}{2g}$=0.40'

FOR A FIRST LOOK, LET US CONSIDER A CROSSING NOT INVOLVING ANY APPLICABLE HYDRAULIC LOSSES, IE A=236.65 sf±

5-8'ϕ, 4-9'ϕ, or 3-10'ϕ Pipes exceed 236.65 sf
So Estimate these as 80 Ft long culverts, both jacked and laid in place. Also consider 3-9'x9' RCB's.

Headwalls:



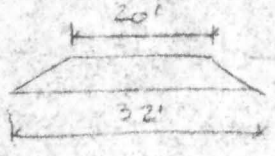
5-8'ϕ; PCC: 5'(8+2)=50' [1(50x10-5x50.27)+1.17(50x5)]$\frac{1}{27}$=20.0 CY ea
Exc: 50x2.17x7x$\frac{1}{27}$ = 28.1 CY ea
Bkfl: 50x2.17x2.00x$\frac{1}{27}$ = 8.0 CY ea

4-9'ϕ; Pcc: 4(9+2)=44' [1(44x11-4x63.62)+1.17(44x5.5)]$\frac{1}{27}$=19.0 CY ea
Exc. 44x2.17x7.5x$\frac{1}{27}$ = 26.5 CY ea
Back: 44x2.17x2.00x$\frac{1}{27}$ = 7.1 CY ea

3-10'ϕ: Pcc: 3(10+2)=36' [1(36x12-3x78.54)+1.17(6x6)]$\frac{1}{27}$=16.6 CY ea
Exc.: 36x2.17x8x$\frac{1}{27}$ = 23.1 CY ea
Back: 36x2.17x2x$\frac{1}{27}$ = 5.8 CY ea

3-9'x9' RCB's: 12" allowances 3(9+1)+1=31'
Pcc: [1(31x4+3x9x9)+1.17(31x5.5)]$\frac{1}{27}$ = 11.0 CY ea
Exc.: 31x2.17x8x$\frac{1}{27}$ = 19.9 CY ea
Back: 31x2.17x2x$\frac{1}{27}$ = 5.0 CY ea

RR DETOUR – SHOOFLY – 1600 LF Single Track on 3' Fill



$\frac{20+32}{2}$ x $\frac{3}{27}$ = 2.89 CY/LF, Use 3 CY/LF

3x1600 = 4800 CY FILL

RCB: 2x31+4x9=62+36=98 sf

$\frac{98x80}{27}$ = 290 CY PCC

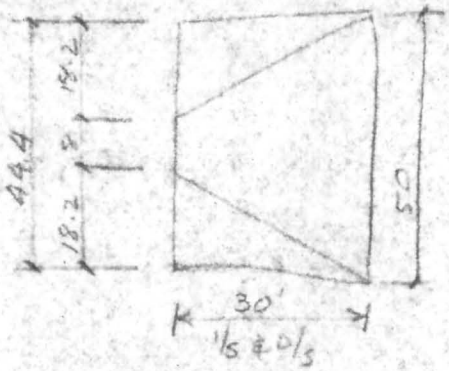
Str. Exc.: Say .5'x31'x80'x$\frac{1}{27}$ = 46 CY
Str. Back: Say 30 CY

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 11-22-68 SUBJECT REACH 5 SHEET NO. 517 OF
CHKD. BY DATE 250' So. BROADFIELD RD. JOB NO. 1317
SPRR Xing

Transitions:

5-8'ϕ:



$\sqrt{18.2^2+9.1^2} = 20.35'$

$20.35+8+20.35 = 48.70$

$9.1+50+9.1 = 68.20$

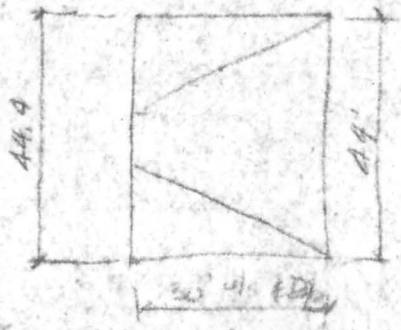
$\frac{68.2+48.7}{2} = 58.45'$

$\frac{60 \times 58.45' \times 5'}{27} = 65$ CY Lining PCC

Cutoffs: $2(48.7)3' \times 1' \times \frac{1}{27} = 11$ CY Struct. PCC

Let Str. Exc. = 3 × Cutoffs = 33 CY Let Backfill = 2 × Cutoffs = 22 CY

4-9ϕ



$44+2\times9.1 = 62.2$

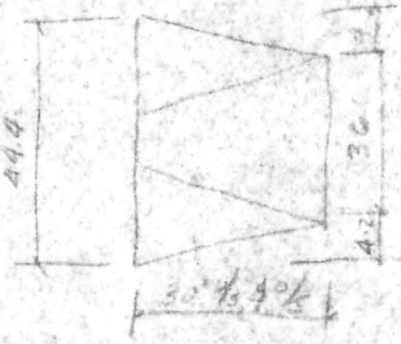
$\frac{48.7+62.2}{2} = 55.45$

$\frac{60 \times 55.45' \times 5'}{27} = 62$ CY Lining PCC

Cutoffs: $2(48.7)3' \times 1' \times \frac{1}{27} = 11$ CY Struct. PCC

Str. Exc.: $3 \times 11 = 33$ CY Backfill = $2 \times 11 = 22$ CY

3-10'ϕ



$9.1+36+9.1 = 54.2'$

$\frac{54.2+48.7}{2} = 51.45'$

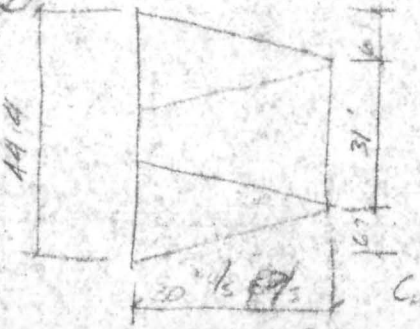
$\frac{4.2}{\tan 30°} = 7.3'$ $\frac{4.2}{\tan 22.5°} = 10.1'$

$\frac{60 \times 51.45' \times 5'}{27} = 57$ CY Lining PCC

Cutoffs: $2(48.7)3' \times 1' \times \frac{1}{27} = 11$ CY Struct PCC

Str. Exc.: $3 \times 11 = 33$ CY Backfill = $2 \times 11 = 22$ CY

3-9×9 RCB



$\frac{6.7}{\tan 30°} = 11.6'$ $\frac{6.7}{\tan 22.5°} = 16.2'$

$9.1+31+9.1 = 49.2'$

$\frac{49.2+48.7}{2} = 48.95'$

$\frac{60 \times 48.95' \times 5'}{27} = 54$ CY Lining PCC

Cutoffs: $2(48.7)1' \times 1' \times \frac{1}{27} = 11$ CY

Str. Exc.: $3 \times 11 = 33$ CY Backfill = $2 \times 11 = 22$ CY

McCREARY · KORETSKY · ENGINEERS

BY AJW DATE 11-22-68 SUBJECT REACH 5 SHEET NO. 518 OF
CHKD. BY DATE 250' S. BLOOMFIELD ROAD JOB NO. 1317
SPRR X'ING COSTS

RR SHOOFLY ONLY:

Track, in place	1600 LF	$ 20.00	$ 32,000
Embankment	4800 CY	2.00	9,600
Misc.	LS		4,000
			$ 45,600

5-96"ϕ RCP - No Drop			Jacking	Shoofly
96"ϕ RCP	400 LF	$ 80.64/115.20	$ 32,256	$ 46,080
Jacking Same	400 LF	200.00/N.A.	80,000	—
RR Shoofly	LS	N.A./45,600	—	45,600
Str. Exc.	89 CY	4.00	356	356
Backfill	38 CY	6.00	228	228
Lining Concrete	65 CY	60.00	3,900	3,900
Str. Concrete	51 CY	90.00	4,590	4,590
			$ 121,330	$ 100,754

4-108"ϕ RCP - No Drop				
108"ϕ RCP	320 LF	$ 98.28/140.40	$ 31,450	$ 44,928
Jacking Same	320 LF	200.00/N.A.	64,000	—
RR Shoofly	LS	N.A./45,600	—	45,600
Str. Exc.	86 CY	4.00	344	344
Backfill	36 CY	6.00	216	216
Lining Concrete	62 CY	60.00	3,720	3,720
Str. Concrete	49 CY	90.00	4,410	4,410
			$ 104,140	$ 99,218

3-120"ϕ RCP - No Drop				
120"ϕ RCP	240 LF	$ 117.60/168.00	$ 28,224	$ 40,320
Jacking Same	240 LF	200.00/N.A.	48,000	—
RR Shoofly	LS	N.A./45,600	—	45,600
Str. Exc.	79 CY	4.00	316	316
Backfill	34 CY	6.00	204	204
Lining Concrete	57 CY	60.00	3,420	3,420
Str. Concrete	44 CY	90.00	3,960	3,960
			$ 84,124	$ 93,820

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BY AJW DATE 11-22-68 SUBJECT REACH 5 SHEET NO. 519 OF
CHKD. BY DATE 250' S. BROOMFIELD RD. JOB NO. 1317
SPKR LINE COSTS

3- 9x9 RCB — No DROP

Str. Exc.	73	CY	4.00	$ 292
Backfill	32	CY	6.00	192
Lining Concrete	54	CY	60.00	3,240
Str. Concrete	323	CY	90.00	29,070
RR Shoring		LS	45600.00	45,600
				$ 78,394

USE PROFILE 1 D/S, EITHER 2 OR 3 @ SPRR
This involves dropping 2.6' or 4'
A structure similar to the SPRR Xing on the 2nd Progress Report Alignment may be used.

CONSIDER 120"ϕ x 80 LF RCP, Jacked
120"ϕ = 78.54 SF 8'x8.8" = 70.4 SF for referenced structure
Q = 1200 cfs n = .013 $d^{8/3}$ = 464

$$Q = \frac{.463 d^{8/3} S^{1/2}}{n}$$

$$S^{1/2} = \frac{Qn}{.463 d^{8/3}} = \frac{1200 \times .013}{.463 \times 464} = \frac{15.6}{214.8} = .072626$$

S = .005275 L = 80' SL = 0.42'

$$V_2 = \frac{1200}{78.54} = 15.28 \text{ fps} \quad \frac{V_2^2}{2g} = 3.63$$

For the canal, V_1 = 5.07 fps $\frac{V_1^2}{2g} = 0.40$

$\Delta h_v = 3.63 - .40 = 3.23'$

Entrance Loss = 0.25 Δh_v $1.15 \Delta h_v = 3.71'$
Exit Loss = 0.90 Δh_v SL = 0.42'
$1.15 \Delta h_v$ 4.13'

∴ USE 120"ϕ FOR 4' DROP

CONSIDER 2-96"ϕ x 80 LF RCP, Jacked
96"ϕ = 50.27 SF $\frac{1200}{2} = 600$ $\frac{600}{50.27} = 11.94$ fps $\frac{V_2^2}{2g} = 2.21'$

$\Delta h_v = 2.21 - .40 = 1.81$

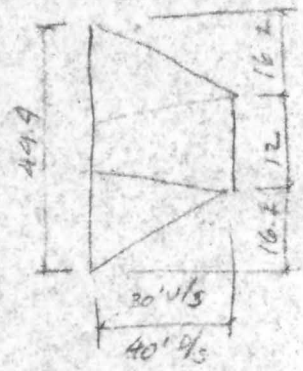
$$S^{1/2} = \frac{Qn}{.463 d^{8/3}} = \frac{600 \times .013}{.463 \times 256} = \frac{7.8}{118.5} = .065823 \quad S = .004333$$

SL = 80 x .004333 = .35'
$1.15 \Delta h_v$ = 2.08
2.43' ∴ USE 2-96"ϕ FOR 2.6' DROP

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BY A/W DATE 11-22-68 SUBJECT REACH 5 SHEET NO. 52 OF
CHKD. BY DATE 250' S Riverside Road JOB NO. 1317
SPRR Xing

COST FOR 4' DROP



$\frac{16.2}{\tan 30°} = 28.1'$

$\frac{16.2}{\tan 22.5°} = 39.1'$

			$
120" ϕ RCP	80 LF	117.60	9,408
Jacking Same	80 LF	200.00	16,000
Str. Exc.	41 CY	4.00	164
Backfill	24 CY	6.00	144
Lining Conc.	52 CY	60.00	3,120
Str. Conc.	22 CY	90.00	1,980
			$ 30,816

PCC Headwall Cutoff $[(12' \times 12' - 78.54)1' + 6 \times 1.17 \times 12^2]\frac{1}{27} = 5.5$ CY ea

$48.7 \times 1 \times 3 \times \frac{1}{27} =$ 5.4

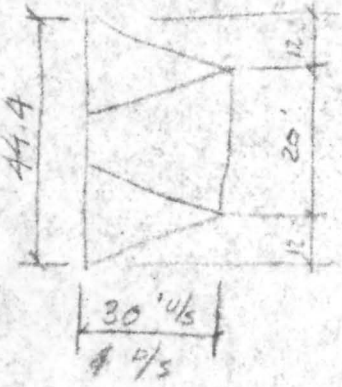
10.9 × 2 = 21.8 CY

Lining $\frac{48.7 + 10 + 12 + 10}{2} = 40.35'$ $\frac{70 \times 40.35 \times 5'}{27} = 52$ CY

Str. Exc. $(3 \times 48.7 \times 3 + 12 \times 8 \times 1.17)\frac{2}{27} = (438 + 112)\frac{2}{27} = 41$ CY

Back. $(3 \times 48.7 \times 2 + 12 \times 2 \times 1.17)\frac{2}{27} = (292 + 25)\frac{2}{27} = 24$ CY

COST FOR 2.6' DROP



			$
96" ϕ RCP	160 LF	80.64	12,902
Jacking Same	160 LF	200.00	32,000
Str. Exc.	45 CY	4.00	180
Backfill	26 CY	6.00	156
Lining Conc.	49 CY	60.00	2,940
Str. Conc.	27 CY	90.00	2,430
			$ 50,608

$\frac{12.2}{\tan 30°} = 21.2'$ $\frac{12.2}{\tan 22.5°} = 29.4'$

PCC Headwall Cutoff $[(16' \times 20' - 2 \times 50.27^{D})1' + 5' \times 1.17' \times 20']\frac{1}{27} = 8.0$ CY ea

Same as above 5.4

13.4 × 2 = 26.8

Lining $\frac{48.7 + 10 + 20 + 10}{2} = 44.35$ $\frac{60 \times 44.35 \times 15}{27} = 49$

Str. Exc. $(3 \times 48.7 \times 3 + 20 \times 7 \times 1.17)\frac{2}{27} = (438 + 164)\frac{2}{27} = 45$ CY

Back. $(3 \times 48.7 \times 2 + 20 \times 2 \times 1.17)\frac{2}{27} = (292 + 47)\frac{2}{27} = 26$ CY

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BY AWH DATE 11-2068 SUBJECT REACH 5, SHEET NO. 5 22 OF
CHKD. BY DATE 250' So. BLOOMFIELD ROAD JOB NO. 1317

STA.	O.G.	PROFILE 1				PROFILE 2			PROFILE 3		
S=.00127		I.E.	d	AREA CUT	AREA FILL	d 2.6 Ic	AREA CUT	AREA FILL	d 1.4 Ic	AREA CUT	AREA FILL
0+00		142.4									
0+75		142.495		0	0		0	0		0	0
1+25	158.8	142.559	16.24	657	0	13.64	481	0	12.24	398	0
4+00	158.0	142.908	15.09	516	0	12.49	412	0	11.09	335	0
6+00	157.5	143.162	14.34	526	0	11.74	370	0	10.34	299	0
8+00	157.5	143.416	14.08	509	0	11.48	355	0	10.08	284	0
10+00	157.0	143.670	13.33	462	0	10.73	316	0	9.33	249	0
12+00	156.0	143.924	12.08	388	0	9.48	256	0	8.08	195	35
13+00	156.5	144.051	12.45	410	0	9.85	273	0	8.45	210	21
17+00	156.5	144.559	11.94	381	0	9.34	249	0	7.94	190	40
18+50	157.0	144.750	12.35	398	0	9.65	263	0	8.25	202	28
22+00	157.5	145.194	12.31	402	0	9.71	266	0	8.31	205	26
23+00	158.0	145.321	12.68	423	0	10.08	284	0	8.68	220	13
24+30	158.5	145.702	12.80	430	0	10.20	290	0	8.80	225	9
25+40	159.2	145.956	13.04	444	0	10.44	302	0	9.04	236	2
29+00	160.0	146.083	13.92	479	0	11.32	347	0	9.92	276	0
30+00	160.5	146.210	14.29	523	0	11.69	367	0	10.29	294	3
31+00	160.5	146.337	14.16	514	0	11.56	360	0	10.16	288	0
33+00	160.0	146.591	13.41	467	0	10.81	320	6	9.41	252	0
39+00	160.2	147.353	12.65	421	0	10.05	282	0	8.65	219	14
41+00	161.0	147.607	13.39	466	0	10.79	319	0	9.39	251	0
43+00	162.0	147.861	14.14	513	0	11.54	359	0	10.14	287	0
45+00	163.0	148.115	14.89	563	0	12.29	400	0	10.89	324	0
46+60	164.0	148.318	15.68	617	0	13.08	447	0	11.68	366	0
47+40	164.2	148.420	16.78	697	0	14.18	516	0	12.78	429	0
48+00	164.9	148.496	19.90	784	0	15.30	591	0	13.90	498	0

2,234,461 CF
82758 CY

1,540,381 CF 0 CF
57051 CY

1,219,923 CF 109,236 CF
45183 CY 4058

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BY AJW DATE 11-25-68 SUBJECT REACH 5 SHEET NO. 523 OF
CHKD. BY DATE 250' S. BLOOMFIELD ROAD JOB NO. 1317

STA	O.G.	PROFILE 4				PROFILE 5			PROFILE 6		
		IE	d	AREA		d	AREA		d	AREA	
				CUT	FILL		CUT	FILL		CUT	FILL
0+00		142.400									
0+75		142.50		0	0					0	0
1+25	158.8	142.56	16.24	657					14.84	559	
4+00	158.0	142.91	15.09	576					13.69	484	
6+00	157.5	143.16	14.34	526					12.94	438	
8+00	157.5	143.42	14.08	509					12.68	423	
10+00	157.0	143.67	13.33	462					11.93	380	
12+00	156.0	143.92	12.08	388					10.68	314	
13+00	156.5	144.05	12.45	410					11.05	333	
17+00	156.5	144.56	11.94	381					10.54	307	
16+50	157.0	144.75	12.25	398					10.85	322	
22+00	157.5	145.19	12.31	402					10.91	325	
23+00	157.0	145.32	12.68	423			Same as 4		11.28	345	
26+00	158.5	145.70	12.80	430					11.40	351	
		145.956	13.04	444					11.64	364	0
28+00	159.0	148.556	10.49	302		9.04	236	2			
29+00	160.0	148.68	11.32	347		9.92	276	0		Same as 5	
30+00	160.5	148.81	11.69	367		10.29	294	0			
31+00	160.5	148.94	11.56	360		10.16	288	0			
33+00	160.0	149.19	10.81	320		9.41	252	0			
39+00	160.0	149.95	10.05	282		8.65	219	14			
41+00	161.0	150.21	10.79	319		9.39	251	0			
43+00	162.0	150.46	11.54	359		10.14	287	0			
45+00	163.00	150.71	12.29	400		10.89	324	0			
46+60	164.00	150.92	13.08	447		11.68	366	0			
47+40	165.2	151.02	14.18	516		12.78	429	0			
48+00	166.4	151.096	15.30	591	0	13.90	498	0			
				1,239,888 CF	0 CF		1,234,988 CF	0 CF		1,015,528 CF	0 CF
				696,390	0		555,210	5700		535,210	5400
				1,931,278 CF	0 CF		1,790,098 CF	5,700 CF		1,570,738	5,400 CF
				71,529 CY	0 CY		66,300 CY	211 CY		58,176 CY	211 CY

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BY A.W. DATE 11-21-68 SUBJECT REACH 5, COST RECAP. SHEET NO. 524 OF
CHKD. BY DATE ALL UNLINED JOB NO. 1317

2ND PROGRESS RPT. ALIGNMENT			PROFILE 1	PROFILE 2	PROFILE 3
			$	$	$
US 101 Xing	LS		56,602	56,005	56,396
Drop Structure	LS		—	9,620	9,620
SPRR Xing	LS		12,720	12,720	12,720
Outlet Structure	LS		20,772	20,772	20,772
Canal Excavation	1.20	85,930 CY	103,116	68,420 CY 82,104	61,050 CY 73,260
Canal Embankment	0.80	31,660 CY	25,328	32,710 CY 26,168	33,710 CY 26,968
			$ 218,538	$ 207,389	$ 199,736
Plus 25%					49,934
					249,670
R.O.W.	3,000.00	19.233A			57,699
					$ 307,369

[See Next Sheet]

250' SOUTH OF BLOOMFIELD ROAD			PROFILE 1	PROFILE 2	PROFILE 3
US 101 Xing	LS		$ 56,602	$ 56,005	$ 56,396
SPRR Xing	LS		79,648	79,648	79,648
Outlet Structure	LS		20,772	20,772	20,772
Canal Excavation	1.20	82,760 CY	99,312	57,050 CY 68,460	45,180 CY 54,216
Canal Embankment	0.80	0 CY	—	0 CY —	4,060 CY 3,248
			$ 256,334	$ 224,885	$ 214,280

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BY AW DATE 11-25-68 SUBJECT REACH 5, COST RECAP, ALL UNLINED SHEET NO. 525 OF

CHKD. BY DATE JOB NO.

250' SOUTH OF BLOOMFIELD ROAD		PROFILE 4	PROFILE 5	PROFILE 6
US101 Xing	LS	$ 56,005	$ 56,396	$ 56,396
SPRR Xing	LS	50,608	30,816	50,608
Outlet Structure	LS	20,772	20,772	20,772
Canal Excavation	1.20	71,530 CY 85,836	66,300 CY 79,560	58,180 CY 69,816
Canal Embankment	0.80	0 CY 0	210 CY 168	210 CY 168
		$ 213,221	187,712	197,760
Plus 25%			46,928	
			234,640	
R.O.W.	3,000.00	10.783A	32,349	
			$ 266,989	

USE 250' SOUTH OF BLOOMFIELD ROAD, PROFILE 5.

US101 Xing: 120" ϕ x160LF RCP, Jacked
SPRR Xing: 120" ϕ x80LF RCP, Jacked

Lined channels:

$b = 8'$ Min.
$d = 8'$ Min. where possible
$z = 1.5$ Max. for subcritical, 1.0 only for supercritical
$n = .014$

Let us investigate $Q = 1200$ cfs, $S = .00127$

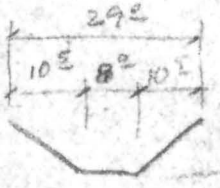
$$Q = \frac{k' b^{8/3} S^{1/2}}{n} \qquad k' = \frac{Qn}{b^{8/3} S^{1/2}}$$

$$k' = \frac{1200 \times .014}{256 \times .03564} = \frac{16.8}{9.124} = 1.841$$

$$\frac{D}{b} = .872 \qquad D = 8 \times .872 = 6.98'$$

$$A = bD + zD^2 = 55.84 + 73.08 = 128.92 \text{ sq ft}$$

$$V = \frac{Q}{A} = \frac{1200}{128.92} = 9.31 \text{ fps} \qquad \frac{V^2}{2g} = 1.35'$$



$$\sqrt{9.0^2 + 10.5^2} = \sqrt{159.25} = 12.62$$

$12.62 + 8 + 12.62 = 33.24$

For 4" thick lining, $\frac{33.24}{3} = 11.08$ sq ft

$11.08 \div 27 = 0.4104$ CY/LF

For cost comparison purposes, let us use the most economical unlined configuration for each of the 2 routes for Reach 5.

$$\frac{\text{Area Lined}}{\text{Area Unlined}} = \frac{128.92}{236.65} = .545$$

Let us assume that the lined canal will require 55% of the canal excavation and embankment required by the unlined canal, to allow for the narrow transitions multiply the structure costs by 95%

	2nd Progr Rpt.	250' So. of Bloomfield Rd.
Gross Length	9100 LF	4800 LF
Total Structures	-346	290
Net length to be lined	8754 LF	4510 LF
Lining @ .4104 cy/lf	3593 CY	1851

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BY AJW DATE 11-26-68 SUBJECT REACH 5 SHEET NO. 527 OF
CHKD. BY DATE FULL LENGTH LINING JOB NO. 1317

		2ND PROGRESS REPORT ALIGN	250' SOUTH OF BLOOMFIELD
US101 Xing		#53,576	#53,576
Drop Structure		9,139	N.A.
SPRR Xing		12,084	29,275
Outlet Structure		19,733	19,733
Excavation	#1.20	33,578 CY 40,294	36,465 CY 43,758
Embankment	0.80	18,541 CY 14,833	116 CY 93
Lining Concrete	60.00	3,593 CY 215,580	1,851 CY 111,060
		#365,239	#257,495
Capitalized value of reduced maintenance *	#20,000.00	1.658 M: (33,160)	0.854 M: (17,080)
		#332,079	#240,415
Cost of equivalent unlined canal		#199,736	#187,712

* Ref.: SCCFCWD letter of Oct. 29, 1968
Basis is a saving of about #1,000 per mile per year in maintenance @ 50 years and 4½%

2ND PROGR. RPT. ALIGN.:

Sta 0 ~ to 60 ~ No Lining, thus no change

Sta 60 ~ to 80 ~ Line bottom 2'	2,000 x 3.852 =	7,704 CY	Addtl. Exc. & Backfill
Sta 80 ~ to 91 ~ Line bottom 3'	1,100 x 4.444 =	4,888 CY	"
		12,592 CY	"

61,050 CY Exc. + 12,592 = 73,642 CY Exc.

33,710 CY Back. + 12,592 = 46,302 CY Back.

250' S. BLOOMFIELD ROAD:

Sta 0 ~ to 28 ~ Line bottom 8'	2,800 x 6.222 =	17,422 CY	Addtl. Exc. & Backfill
Sta 28 ~ to 38 ~ Line bottom 4'	1,000 x 5.037	5,037 CY	"
Sta 38 ~ to 48 ~ Line bottom 3'	1,000 x 4.444	4,444 CY	"
		26,903 CY	"

66,300 CY Exc. + 26,903 = 93,203 CY Exc.

210 CY Back. + 26,903 = 27,113 CY Back.

			2ND PROG. REPORT ALIGN.		250' SO. BLOOMFIELD RD.	
US 101 Xing.	LS		1	$ 56,396	1	$ 56,396
Drop Structure	LS		1	3,620	—	—
S.P.R.R. Xing.	LS		1	12,720	1	30,816
Outlet Structure	LS		1	20,772	1	20,772
Canal Excavation	$ 1.20/CY		93,642 CY	88,370	93,203 CY	111,844
Canal Embankment	0.80/CY		46,302 CY	37,042	27,113 CY	21,690
				$ 224,920		$ 241,518
Plus 25%				56,230		60,380
				$ 281,150		$ 301,898
R.O.W.	$ 3,000.00/A		19.233A	57,699	10.783A	32,349
				$ 338,849		$ 334,247

2ND PROGRESS REPORT AUGMENT

U.S. 101 Xing -		LS	$ 56,396
S.P.R.R. Xing -		LS	12,720
Outlet Structure		LS	20,772
Canal Excavation	61,050 CY	$ 1.20	73,260
Canal Embankment	33,710 CY	0.80	26,968
			$ 190,116
Plus 25%			47529
			$ 237,645
R.O.W.	19.233A	$ 3,000.00	57699
			$ 295,344

250' SOUTH OF BLOOMFIELD ROAD

U.S. 101 Xing		LS	$ 56,396
S.P.R.R. Xing		LS	30816
Outlet Structure		LS	20,772
Canal Excavation	66,300 CY	$ 1.20	79,560
Canal Embankment	210 CY	0.80	168
Soil Cement Lining	36,826 SY	1.50	55,239
			$ 242,951
Plus 25%			60738
			$ 303,689
R.O.W.	13.868 A	$ 3,000.00	41604
			$ 345,293

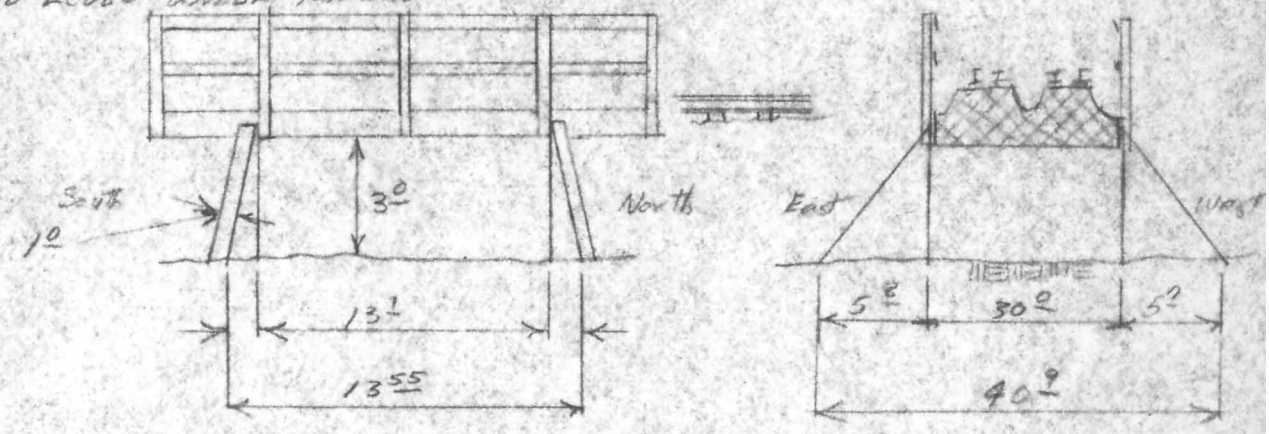
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BY ..... DATE ..... SUBJECT SPRR Trestles SHEET NO. 530 OF .....

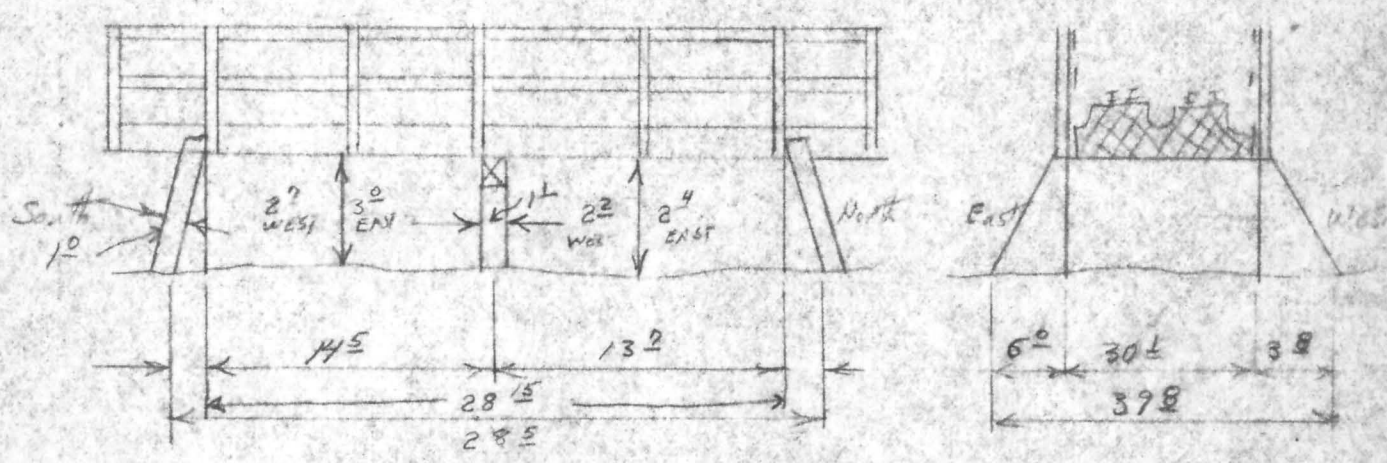
CHKD. BY ..... DATE ..... JOB NO. 1317

MEASUREMENTS IN FEET & TENTHS

(a) 1 - CRACK NORTH WALL CENTER
(b) 2 - CRACKS SOUTH WALL CENTER = / \
(c) GROUND LEDGE UNDER BRIDGE



2ND TRESTLE SOUTH OF MILLER SIDING



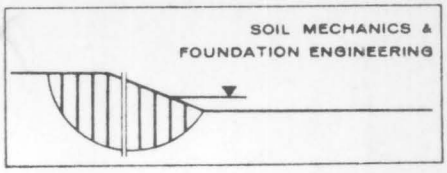
1ST TRESTLE SOUTH OF MILLER SIDING

(a) TOOK DEPTH UNDER TRESTLE AT EAST & WEST SIDES
DEPTH & SLIGHTLY DEEPER THEN ON ENDS

GEO-ENGINEERING CONSULTANTS

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Phone 626-4535



20 December 1968

GEO No. 2985

SOIL EXPLORATION FOR THE

GAVILAN CREEK FLOOD CONTROL IMPROVEMENT PROJECT

SANTA CLARA COUNTY, CALIFORNIA

SCOPE

This report describes a soils investigation in the area of the proposed Gavilan Creek Flood Control Improvement Project, Santa Clara County, California. The purpose of the investigation was to obtain information regarding the soil profile at specified locations along potentially feasible routes of new flood control canals, and to provide test data to be used in design of the canals. Specifically, it was required to classify materials at each location according to the "Unified Soil Classification System", and to recommend side slope gradients for the canals where stability analyses indicate that a side-slope ratio of 2:1 would be unstable.

SITE DESCRIPTION

The project area is located along a terrace and the alluvial plain below the watershed area. The terrace slopes moderately downward from the base of the hills to about Elev. 200, where there is an abrupt drop of 10 to 20 ft in elevation to the gently sloping alluvial plain.

FIELD EXPLORATION

Ten test borings were drilled at locations shown on the attached Plate 1. Drilling and sampling techniques, together with supplementary data regarding boring logs are shown on Plate 1A, and detailed descriptions of soil types noted at each boring location are shown on the Boring Logs, Plates 2 to 11.

The one boring drilled in the terrace area (No. 10) indicates that the soil there is an older, very coarse alluvium with partially weathered rock fragments and semi-angular gravel fragments, but having a predominantly clayey, cohesive texture. The remainder of the borings were located in the plain below the terrace, where it was found that the soils are a moderately well-sorted alluvium with clayey soils in the upper 2 to 8 ft, overlying predominantly granular soils. The granular soils vary in texture from silts to sands with varying proportions of silt and clay sizes.

LABORATORY TESTS

All samples obtained from the borings were inspected by the supervising soils engineer, and typical samples were selected for testing to determine their relevant properties. Sieve analyses and Atterberg Limit (Plastic and Liquid Limits) tests were performed for use in classification by the "Unified" system, and various types of shear strength tests were performed for use in stability analyses. Results of the tests are shown on the Boring Logs and on Plates 12 to 15.

CLASSIFICATION

The appropriate classification symbols are shown on the boring logs for each soil type noted in each of the borings. Where the classification

was determined by tests, the symbols are shown underscored and are placed at the elevation of the test sample. Elsewhere the classification symbols are based on field log descriptions, on inspection of individual samples, and on comparison with tested samples. In addition to the classification symbols, the Plasticity Index range is indicated. Where determined by test, the Plasticity Index is underscored; elsewhere it is not.

STABILITY ANALYSES

Stability analyses based on the test values of shear strength indicate that the cohesive soils (CH, CL) would be stable at a slope ratio of 2:1, but that the non-cohesive soils (SP, SW, SM) would not be stable at the 2:1 slope ratio during periods of rapid lowering of the water surface. Although test data are not available for the silt soil (ML) owing to its limited occurrence in the borings, we estimate that its strength, even under a relatively slow lowering of the water surface, would be insufficient for the 2:1 slope ratio. We recommend that slopes in the non-cohesive soils and in silts be made not steeper than 3:1.

SUMMARY

1. The soils found in the one boring drilled in the terrace area are dense mixtures of unsorted and decomposed gravel, sand, silt and clay sizes having appreciable cohesive strength.

2. The soil found in the borings drilled in the plain below the terrace is recent alluvium varying in texture from clays of high plasticity to relatively clean sands. Silty clays predominate at the surface, and partially cohesive to non-cohesive materials generally underlie the clayey surface soils.

3. Side slopes in the cohesive types of soil will be stable at a slope ratio of 2:1, and in the non-cohesive granular soils at a slope ratio not steeper than 3:1.

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Leonard O. Long
Registered Civil Engineer No. 13465

HA 3
HA 1
HA 4
HA 2
HA 6
HA 5
HA 8
HA 7
HA 9
HA 10
RTE 119
RTE 2-C
SOUTHERN
PACIFIC
Miller
2 LANE
ROAD
Creek
BM 157
GEO-ENGINEERING CONSULTANTS
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TEST BORING LOCATIONS
DATE 18 DEC 68
PROJECT No. 2985
G/E FORM 5 10/63
PLATE NO

GEO No. 2985
20 December 1968

Table 1

Field Exploration Procedures and Notes on Logs

1. Drilling Equipment:

   Hand-auger.

2. Sampling Equipment:

   a. Modified California type, 2½-inch O.D. x 2-inch I.D.
   b. Shelby tube type, 3-inch O.D. x 2 7/8-inch I.D.
   c. Samplers advanced by 25 lb. hammer, 18-inch drop.

3. Notes on Boring Logs:

   "Drive No." column - Numerals indicate sample numbers.
   "S" indicates shelby type sampler and "A" indicates auger cuttings; otherwise, the California type sampler was used.

   "Compr. Str." column - Numerals indicate compressive strength, tons per sq ft, in unconfined compression or confined at the approximate overburden pressure. "Sat." indicates samples were saturated before test.

   "Class. Symbol" column - Letters indicate soil classification based on the unified system.
   Underscored symbols indicate classification based on tests of samples from the indicated depth. Where not underscored, classification was by visual and comparative methods.
   Numerals in form "7-10", "10-20" and "20+" indicate range of plasticity index. Numerals followed by "mm" indicate the D_{75} size.

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BORING LOG

PROJECT Gavilan Creek		Project No. 2985	Boring No. HA 1
LOCATION OF BORING See Plate 1			Sheet No. 1/1
			Date Drilled 12/3/68

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F.	Natural Moist %	Comp. Str. T.S.F.	LOG OF MATERIAL	Class. Symbol
				72	43.6	1.06	Stiff silty clay, high to very high plasticity	CL 20+ to CH
		1 S	35					
		2	31					
5		3 S	42	85	36.4	0.89		CH
		4	25					CL 20+
10								

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BORING LOG

PROJECT	Gavilan Creek	Project No. 2985	Boring No. HA 2
LOCATION OF BORING	See Plate 1		Sheet No. 1/1
			Date Drilled 12/3/68

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F	Natural Moist %	Compr. Str. T.S.F	LOG OF MATERIAL	Class. Symbol
		1	50				Stiff silty clay, medium to low plasticity.	CL 10-20
		2	50					
-5		3	25				Stiff silty clay, low plasticity.	CL 7-10
		4	25				Clayey silt.	ML 0.08mm
-10								

G/E Form 7 9/63

PLATE No. 3

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BORING LOG

PROJECT: Gavilan Creek	Project No. 2985	Boring No. HA 3	
LOCATION OF BORING: See Plate 1		Sheet No. 1/1	
		Date Drilled 12/3/68	

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F.	Natural Moist. %	Compr. Str. T.S.F.	LOG OF MATERIAL	Class. Symbol
		1	20	98	17.4	2.93	Stiff silty clay, medium to low plasticity.	CL 10-20
		2	70					
5		3	50			Tx	Silty sand, trace of clay.	SM SM 0.5mm
		4	37					
10								

C/E Form 7 6/63

PLATE No. 4

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BORING LOG

PROJECT: Gavilan Creek | Project No. 2985 | Boring No. HA 4

LOCATION OF BORING: See Plate 1 | Sheet No. 1/1 | Date Drilled 12/3/68

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F.	Natural Moist %	Compr. Str. T.S.F.	LOG OF MATERIAL	Class. Symbol
		1					Stiff silty clays, medium plasticity.	CL 10-20
-5		2					Stiff silty to sandy clay, medium to low plasticity.	CL 7-10 10-20
		3						CL 10-20
		4					Clayey sand.	SC 7-10 0.25mm
-10								

G/E Form 1 9/63

PLATE No. 5

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BORING LOG

PROJECT	Gavilan Creek	Project No. 2985	Boring No. HA 5
LOCATION OF BORING	See Plate 1		Sheet No. 1/1
			Date Drilled 12/3/68

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F	Natural Moist %	Compr. Str. T.S.F	LOG OF MATERIAL	Class. Symbol
		1	37				Stiff silty clay high to very high plasticity.	CH-CL 20+
5		2	30				Stiff silty clay, medium to high plasticity.	CL 10-20
		2 A	-				Fine-gravelly sand, trace clay.	SW-SM 5.5mm
		3	30				Silty fine sand.	SM 1.5mm
10								

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BORING LOG

PROJECT Gavilan Creek	Project No. 2985	Boring No. HA 6	
LOCATION OF BORING See Plate 1		Sheet No. 1/1	
		Date Drilled 12/2/68	

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F	Natural Moist %	Compr. Str. T.S.F	LOG OF MATERIAL	
		1 S	37				Stiff silty clay, low to medium plasticity.	CL 10-20
		2	21					CL 10
		3	28					
5							Fine gravel and sand, trace clay.	SM 5.5mm
							Silty sand, trace of clay.	SM-SC 0.25mm 0-7
		4	18					
		5					Stiff sandy clay, medium plasticity.	CL 10-20
10								

G/E Form 1 4/63

PLATE No. 7

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BORING LOG

PROJECT	Gavilan Creek	Project No. 2985	Boring No. HA 7
LOCATION OF BORING	See Plate 1		Sheet No. 1/1
			Date Drilled 12/2/68

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F	Natural Moist %	Compr. Str. Y.S.F	LOG OF MATERIAL	Class. Symbol
		1	53				Silty to sandy clays with trace of fine, semi-angular gravel.	CL 10-20
		2	70					
5		3	67					
		4	75					
10								

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BORING LOG

PROJECT	Gavilan Creek	Project No. 2985	Boring No. HA 8
LOCATION OF BORING	See Plate 1		Sheet No. 1/1
			Date Drilled 12/2/68

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F.	Natural Moist %	Compr. Str. T.S.F.	LOG OF MATERIAL	Class. Symbol
		1	25				Stiff silty clay, low to medium plasticity.	CL 7-20
		2	25				Silty sand.	SM 0.20mm
5								SM 0.20mm
		3	31	89	20.3	0.99 (sat.)	Stiff silty clay, low to medium plasticity.	CL 7-20
		4	20				Silty sand.	SM 0.20mm
10								

G/E Form 1 9/63

PLATE No. 9

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BORING LOG

PROJECT Gavilan Creek	Project No. 2985	Boring No. HA 9	
LOCATION OF BORING See Plate 1		Sheet No. 1/1	
		Date Drilled 12/2/68	

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F	Natural Moist %	Compr. Str. T.S.F	LOG OF MATERIAL	
		1					Medium-stiff, very silty and sandy clay.	ML – CL 7-10
		2		95	17.6	0.54 (sat.)	Medium-stiff sandy clay, low to medium plasticity.	CL 10-20
5								CL 7-20
		3						
10								

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BORING LOG

PROJECT Gavilan Creek		Project No. 2985	Boring No. HA 10
LOCATION OF BORINGS See Plate 1			Sheet No. 1/1
			Date Drilled 12/2/68

DEPTH FT.	ELEV. FT.	DRIVE NO.	Blows per Foot	Dry Unit Weight P.C.F.	Natural Moist %	Compr. Str. T.S.F.	LOG OF MATERIAL	Class. Symbol
		1					Stiff sandy clay and rock fragments, medium plasticity.	CL 10-20
		2						
5		3						
10								

G/E Form 1 9/63

PLATE No. 11

GEO No. 2985
20 December 1968

Table 2

Strength Test Summary

Sample Location	Depth ft.	Unconfined Strength, TSF	Shear Strength by Triaxial Compression (1) Cohesion, TSF	Friction Angle, deg.
HA 1	2	1.06	-	-
HA 1	6	0.89	-	-
HA 3	2	2.93	-	-
HA 4	6	-	0.14	14
HA 8	5	0.99	-	-
HA 9	4	0.54	-	-

Notes: (1) Saturated, multiple stage, unconsolidated, undrained.
(2) Saturated, confined at 5 psi pressure during test, consolidated at 5 psi, not drained during compression.

Table 3

Plasticity Index Tests (Atterberg Limits)

Sample Location	Depth, ft.	Liquid Limit	Plastic Limit	Plasticity Index
HA 1	6	63	29	34
HA 1	7	45	23	22
HA 4	7	35	23	12
HA 5	3	39	21	18
HA 5	7	n.o.	n.o.	non-plastic
HA 6	3	32	22	10
HA 6	6	28	21	7
HA 8	3	n.o.	n.o.	non-plastic
HA 9	4	34	22	12

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DATE: 12/20/68

PROJECT No. 2985

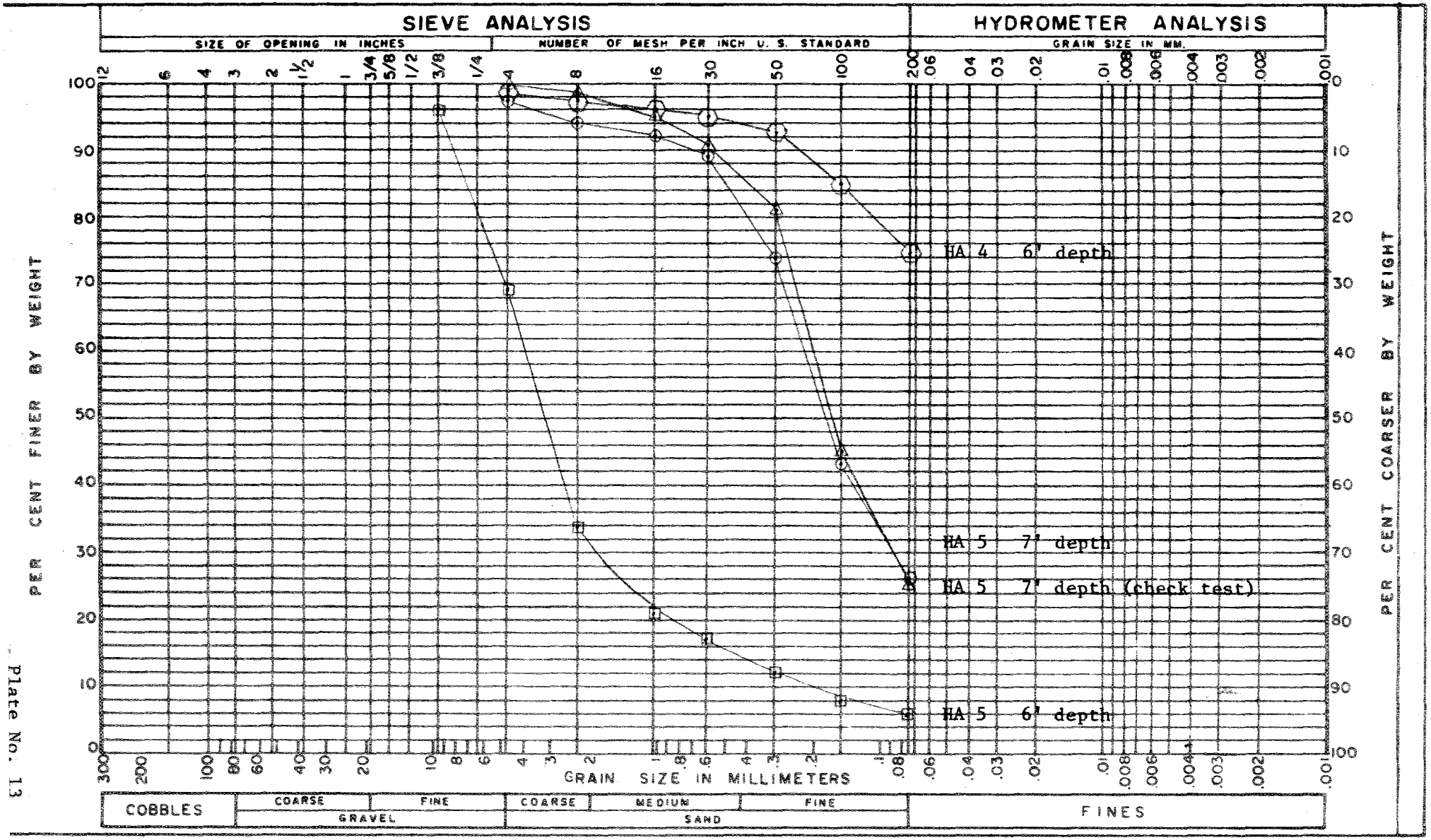


Plate No. 13

IKE FORM 116 9/60

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DATE: 12/20/68

PROJECT No. 2985

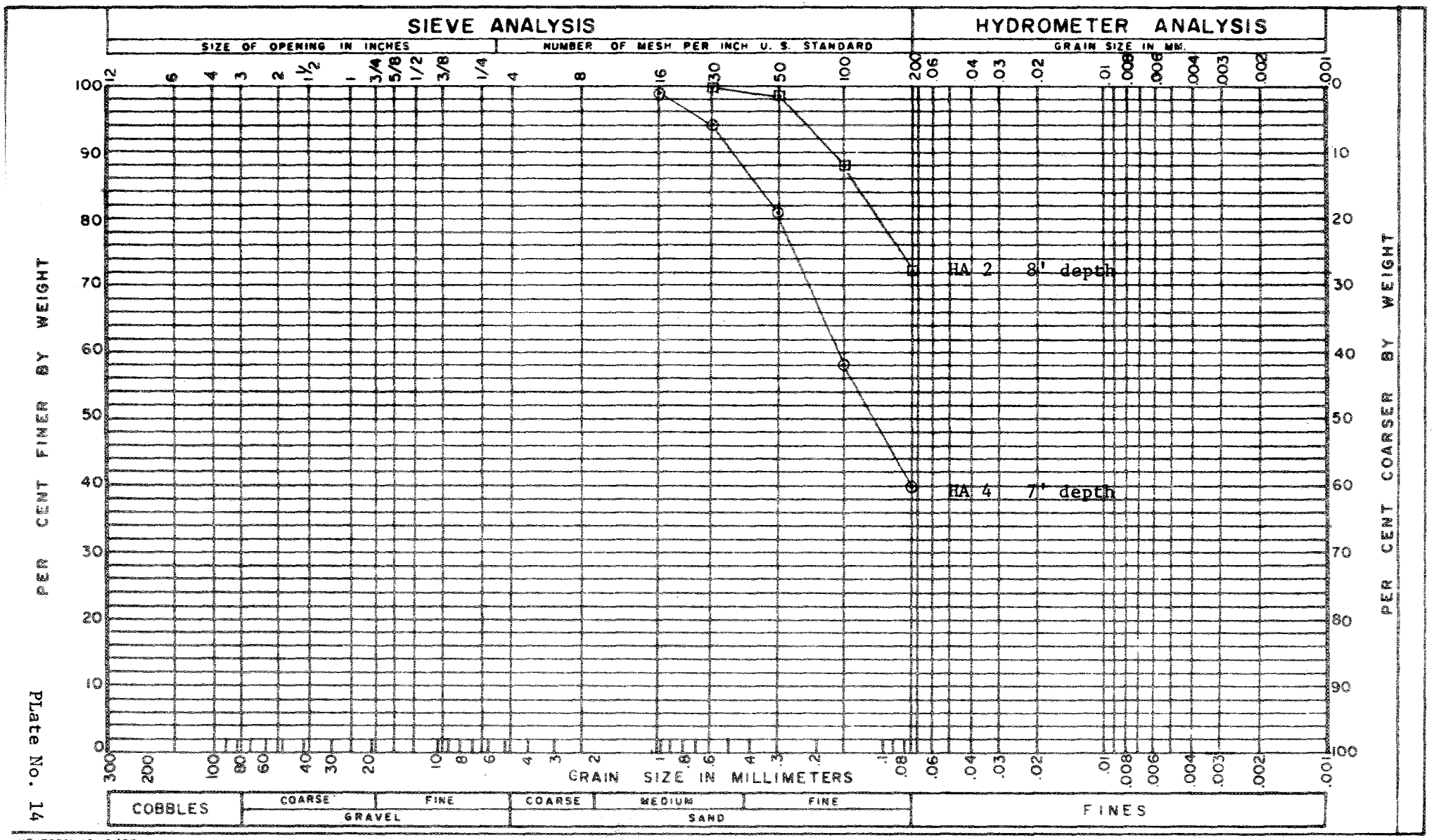


Plate No. 14

UKE FORM 116 9/60

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DATE: 12/20/68

PROJECT No. 2985

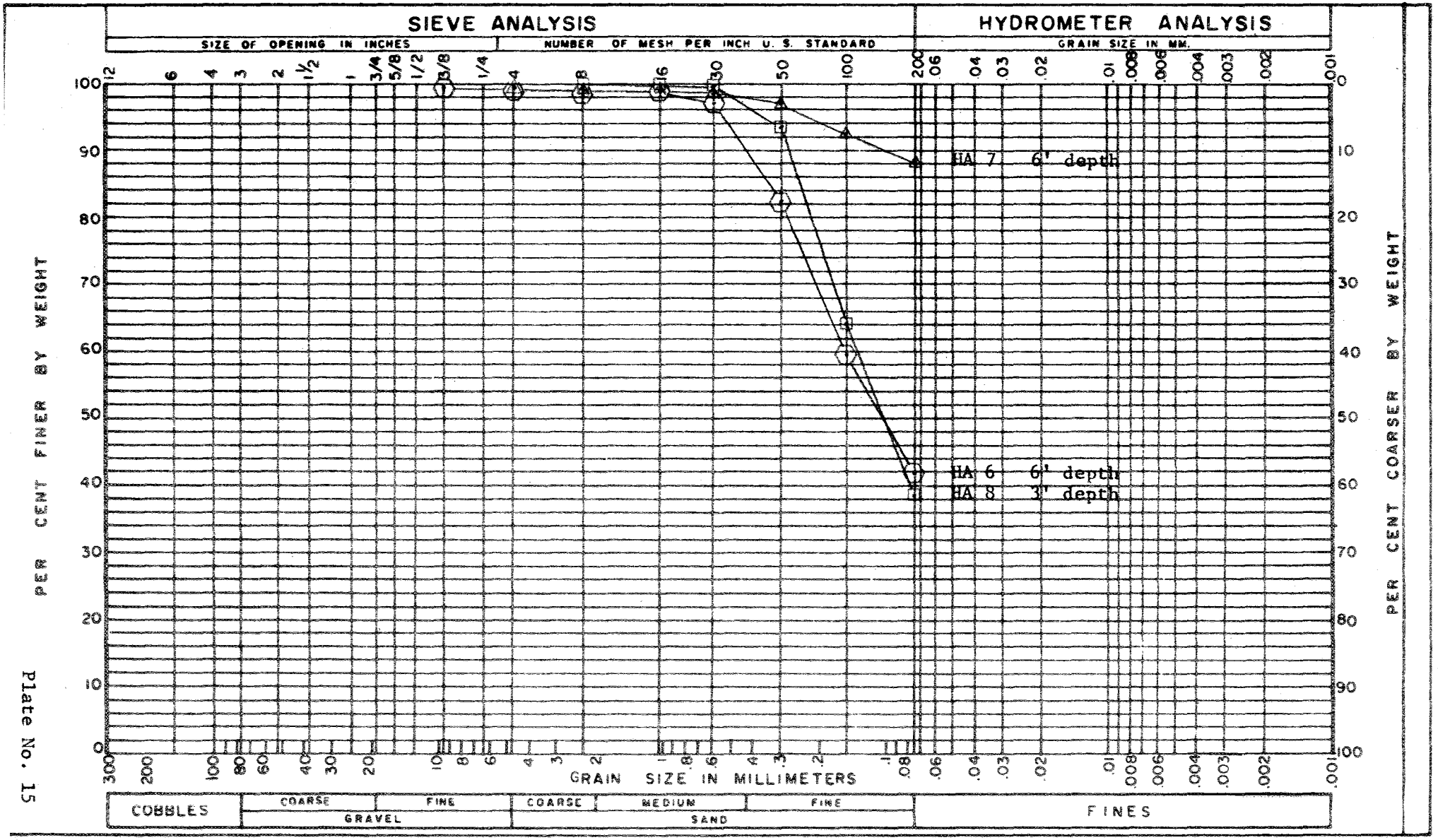


Plate No. 15

NKE FORM 116 9/60